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Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

THE STRONG LOCOMOTIVE bought by the Atchison, Topeka & Santa Fe company some time ago has begun running between Kansas City and Nickerson, 245 miles west. The engine is soon to be put on the Kansas City and Chicago line, and it is said to be the intention to use it to considerably reduce the schedule time between these points.

THE BUFFALO CROSSING QUESTION is not advancing very fast. The Erie is, with great justice and propriety, it seems to us, emphatically objecting to the proposed system of contracting with the different roads independently, or rather contracting with one on plans prepared *ex parte* and then forcing the others to consent to them. The Erie has itself to thank for much of the trouble in which it finds itself, not having shown a co-operative spirit, but rather a disposition to do nothing at all until it is compelled to; but the same is true of other roads. The true method of proceeding in such cases is to determine first what is right to do by proceedings where all have a chance to be heard, and then compel all to do it, whether they wish to or not. This is what the law authorizes, and this is not what the Crossing Commission is now trying to do. A hearing on July 25 was entirely occupied by the presentation of the Erie's case in opposition. What the outcome will be is not yet clear.

THE WORST ACCIDENT of the week was a head collision July 26 on the Atchison, Topeka & Santa Fe at Canon City, N. M., between a freight and a passenger train, killing one of the engineers and injuring several employés. Other collisions have occurred as follows: On July 28 at Terre Haute, Ind., killing one man; on July 23 on the Louisville, Evansville & St. Louis, two collisions, each between two freight trains; on July 23 at Thurston, O., on the Toledo & Ohio Central badly injuring an engineer; on July 22 at Sycamore, Ill., on the Chicago & Northwestern, killing a fireman; on July 25 near Fostoria, O., a head collision between two freight trains on the Columbus, Hocking Valley & Toledo, injuring two tramps; on July 26 on the Western New York & Philadelphia, near Silver Creek, N. Y., killing a boy; on July 26 at Layton, Utah, on the Union Pacific, a rear collision between a special excursion train and an extra freight; on July 26 at Norfolk, Neb., on the Fremont, Elkhorn & Missouri Valley; on July 23 near Chicago another special passenger train collided with a freight train at a level crossing; on July 29 at South Durham, Ont., a head collision between two Grand Trunk passenger trains.

A MUCH WORSE COLLISION than any of the above is reported from England, July 28, between two trains loaded with workmen, on the Manchester Ship Canal. Ten were killed and 60 injured. Inasmuch as the accident was on one of the temporary roads built to carry materials for the canal, and occurred, moreover, from a misplaced switch, it will hardly do to lay the blame of it to English operating practice.

HIGHWAY BRIDGE FAILURES are reported near Delaware, O.; Wellsboro, Ind., killing one man; near Mansfield, Conn., a wooden bridge over the Willimantic River, built 20 years ago; at Clifton Park, N. Y.; at Weston, Ia., and near Brookhaven, Suffolk Co., N. Y. All were small structures.

A BOILER EXPLOSION occurred July 25 at the new Louisville and Jeffersonville bridge. The boiler supplying steam to the air compressor at caisson No. 3 blew up, injuring two men. Fortunately no one was in the caisson at the time, and another boiler was hastily fired up before the air pressure in the caisson had lowered much. This caisson has now been sunk 50 ft.

A DISASTROUS STEAMBOAT COLLISION occurred in Chesapeake Bay on July 28 between an excursion steamer and the *Virginia*, plying between Baltimore and Norfolk. Thirteen of the excursion steamer's passengers were killed and a large number were injured.

THE MOST FATAL CYCLONE which ever visited New England struck South Lawrence, Mass., July 26, killing 8 persons and injuring nearly a hundred.—The Colorado washouts referred to last week prove more serious than at first reported. The Colorado Central division of the Union Pacific will cost $250,000 to repair, according to press reports. The Colorado Midland and Denver and Rio Grande have also suffered considerably.—An earthquake shock was felt at Bakersfield, Cal., July 24.

A NOVEL ARCH, concerning which a note appeared in ENGINEERING NEWS for Feb. 1, was tested at Matzleindorf, Austria, May 16 and 17. The arch had a span of 32.8 ft., a rise of 3.3 ft., is 6 ins. thick at the crown and 8 ins. at the springing line. The material is composed of one part Portland cement and three parts clean river sand. At a distance of 0.8 in. from the soffit is a net of 0.39 and 0.27-in. wire, the thicker wires running transversely to the axis of the arch.

The tests were begun by placing a locomotive weighing 40 tons over the crown, and, after running this off, placing a 53-ton locomotive over a half of the arch; the deflections were measured at 13 places on the soffit with each locomotive. Then a half of the span was loaded with 110 tons of rails, equivalent to a pressure of 1,000 lbs. per sq. ft., which resulted in a deflection of the crown of .12 in. On the following day it was found that the crown had very nearly returned to its original position. A load of 188 tons, equivalent to 1,741 lbs. per sq. ft., of rails was next placed upon a half of the span; this weight caused the abutments to give way, and, on increasing the load to 2,000 lbs. per sq. ft., the arch sank without entirely breaking.

THE DUNMAIL RAISE TUNNEL HEADINGS were joined July 9, according to *Engineering*. This tunnel is 15,558 ft. long, at the head of the aqueduct from Thirlmere to Manchester, England. Starting at the intake, 66 ft. deep and 40 ft. in diameter, the tunnel runs 5,145 ft. to the first angle, then 6,708 ft. to the second angle where the Wythburn shaft, 105 ft. deep, was sunk, then 3,705 ft. to the northern end. The driving has taken nearly 4½ years.

The tunnel line from the Wythburn shaft to the first angle was taken from two plumb lines hung 6 ft. 9 in. apart. The headings met 4,554 ft. from this shaft; the error in alignment was 8.5 ins., in levels, 2 ins.

THE BUSK-IVANHOE TUNNEL CONTRACT has just been let to MICHAEL C. KEEFE, of Butte, Montana, who has recently completed a tunnel 9,000 ft. in length for the Montana Central Ry. As stated in our issue of July 19, this tunnel will be 9,350 ft. in length, and will be when completed the third longest tunnel in the United States. The contract calls for the completion of the work in 20 months. Duplicate machinery will be set up to avoid delays, and the contractor will receive a good bonus for each day gained in time. The drills, air compressers, etc., will all be furnished by the Ingersoll-Sergeant Rock Drill Co.

THE ST. CLAIR TUNNEL lacks about 550 ft. of completion. The shields are being pushed ahead at a rate of about 9 ft. per day from each end, and are expected to meet about Sept. 1. The first train will pass through the tunnel about the middle of October. The company has asked proposals for building the masonry approaches; but it is not yet known whether a second tunnel will be built or not, as has been reported.

NEWARK'S NEW WATER SUPPLY from the Pequannock water-shed in northern New Jersey is expected to be of unrivaled purity. Work is in progress on the two storage reservoirs, one about two miles from Oak Ridge and the other at Clinton. The first reservoir will cover about 430 acres and 3,000,000,000 galls. of water will be impounded. The second reservoir will cover 456 acres and will have about the same capacity. About 500 men are employed on the works.

THE BURNING OF WALLACE, IDAHO, and another fire at Spokane Falls have directed anew the attention of Pacific coast cities to the subject of adequate water supply. Spokane Falls has hitherto been supplied by direct pumping, but at a citizens' meeting on July 25 it was voted to establish an ample reservoir system at once. Seattle, which also suffered a terrible conflagration some months ago, is hurrying the work of adding to her water supply facilities and proposes the construction of a gravity system at a cost of about $1,000,000.

ONLY ETERNAL VIGILANCE WILL SECURE PURE WATER SUPPLY is a fact which the citizens of Rochester, N. Y., are fast finding out. In ENGINEERING NEWS of April 28, 1888, will be found an account of the system of sanitary inspection adopted to preserve from contamination the water of Hemlock Lake, which furnishes the supply of potable water for the City of Rochester. Under the provisions of the New York State law for the sanitary protection of public water supplies, the entire water shed supplying Hemlock Lake was inspected three years ago, and regulations were put in force concerning the disposal of sewage, manure, night soil, etc. Of late the inspection has been given up, and as a consequence some of the farmers cultivating land on the water-shed returned to their old habits, keeping pigs over running streams, etc. The sanitary committee of the Rochester Board of Health recently visited the lake and discovered various abuses of this sort, and prompt action is to be taken for their remedy. It should be said that the whole expense for protecting the lake from contamination has thus far been trifling. The example of Rochester is one which might well be followed by many other cities taking supplies from streams or lakes having well-populated watersheds. It is not yet determined whether a second conduit to Hemlock Lake will be built or not.

SYRACUSE CAN NOW TAKE WATER from Skaneateles lake. A court decision recently rendered dismisses the injunction brought by WM. A. SWEET and others to restrain the city from issuing bonds, and affirms the right of the city to carry out its proposed works, using this as the source of supply.

THE MISSOURI RIVER POWER CO. have begun the construction of a dam across the Missouri River, near Helena, Mont., to develop about 20,000 HP. It will be a timber crib structure, 47 ft. high and 800 ft. long, forming an impounding reservoir with an area of 429 miles. The water will be taken from above the dam to the turbines by a tunnel 15 ft. × 17 ft. cross-section driver, through a rock promontory adjoining the dam. The total cost is estimated at $100,000. The power developed is to be transmitted electrically to Helena, 13 miles distant. ROBERT J. JOHNSON, of Helena, is Chief Engineer, and E. F. FULLER, of New York City, is Consulting Engineer. Among other important water-power enterprises

now under way are one at Sault Ste. Marie, Mich., the contract for which has just been let to Norton & Co., of Chicago; one at Topeka, Kan., where a $1,000,000 dam is to be built by Anthony Holmes & Co., and one at Austin, Tex., where the Colorado River is to be dammed at a cost of $1,400,000.

FLUCTUATIONS OF IRON AND STEEL PRICES in England during the last five years are conveniently shown in the following table in Messrs. Matheson & Grant's Engineering Trades' Report:

	Per ton.						
	July 1885.	July 1886.	July 1887.	July 1888.	July 1889.	Jan. 1890.	July 1890.
	£	£	£	£	£	£	£
Steam coal, f. o. b. Cardiff	2.49	2.18	2.31	2.55	3.18	3.42	3 62
West Hartley coal, f. o. b. Newcastle	2.18	2 06	2.12	2.06	2.31	2.93	3.18
Pig iron at Glasgow, No 3	9.96	9.48	10.32	10.08	10.66	15.33	11.16
Pig iron at Middlesbrough, No. 3	7.77	7.29	8.40	7.77	9.72	15.06	10.47
Iron ship plates at Middlesbrough	23.08	21.26	22.47	23.69	30.37	40.09	26.63
Iron bridge plates in South Yorkshire	29.16	25.51	26.12	30.37	34.02	41.31	31.50
Steel ship and bridge plates	34.02	30.37	30.37	34.02	36.45	46.17	34.02
Steel rails, f. o. b.	24.30	19.44	20.16	19.44	24.30	34.02	24.30

THE NEW YORK FIRE DEPARTMENT in the three months ending March 31, 1890, answered 959 alarms, 896 of which proved to be for actual fires. Of these 566 were extinguished without an engine stream, 205 with one engine stream, 88 with two or three engine streams, while 37 required more than three engine streams. Of 878 fires in buildings, 815 were confined to the point of starting, 55 were confined to the building, and only 8 extended to other buildings. Considering the fact that in several of the serious fires the department was handicapped by the insufficient water supply, this is a very creditable record. Superstitious people will doubtless be gratified to learn that more fires started on Friday than on any other day in the week.

A NOVEL PLAN for making a world's fair site on the Chicago Lake front is to enclose the area to be reclaimed by a gigantic coffer-dam, 45 ft. wide on the top, and then pump out the water. The projectors of this plan have offered to do the work for $1,250,000.

IMMIGRATION, during the last fiscal year, ending June 30, shows a slight increase, the number arriving being 451,219, as against 438,619 during the fiscal year 1889, an increase of 12,600. Unfortunately, there was a considerable increase in the number of immigrants arriving from Southern Europe, viz.: from Italy, 26,943; from Austria-Hungary, 22,004; from Russia, including Poland, 7,821; while there was a decrease in the number of immigrants arrived from Great Britain and Ireland of 30,816; from Sweden and Norway, 7,824, and from Germany, 7,082

CAR HEATING SYSTEMS used in Maine must have the approval of the State Railroad Commission. On Aug. 12 the Commission will hold a session at Augusta to consider applications for the approval of any system which any railway may desire to use.

THE NEW YORK STEAM COMPANY and the city authorities are still disputing over the effect of the company's mains upon the streets, buildings, water mains, etc., in the lower part of the city. The company has had several well known experts upon the stand to testify to the general innocent nature of its pipes, but does not seem to have proven as yet that the heat in the sewers, water mains, electric subways and sidewalk vaults is not due to the radiation and leakake from its mains.

A REPORT FROM JOHNSTOWN, PA., states that the total number of lives lost in the flood of June, 1889, is 2,187.

NATURAL GAS in large quantity is said to have been struck at Kingsville, Ont. The borings are 900 ft. deep, and the flow is estimated at 20,000,000 cu. ft. per day.

THE PROPOSED ISSUE OF WORLD'S FAIR BONDS to the amount of $5,000,000 by the city of Chicago has been rendered feasible by the passing of the necessary constitutional amendment in both houses of the Illinois Legislature.

The Mannesmann Process of Making Weldless Tubes.

From addresses by Prof. REULEAUX, before the German Railway Club, and Mr. J. G. GORDON, before the Society of Arts, we abstract the following description of the remarkable and interesting method of rolling tubes from a solid bar which was invented by Messrs. REINHARD and MAX MANNESMANN, of Remsheid, Germany.

The process can be understood better if the reader will recall what takes place during the motion of a

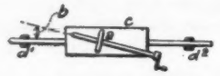


FIG. 1. Skew Friction Gear.

pair of skew friction wheels. In Fig. 1, c is a large cylinder mounted on a shaft which is free to revolve and move longitudinally in the bearings d_1 and d_2. The small wheel, a, presses against c and is mounted on a shaft making an angle b with the axis of c. If a is revolved with a velocity v, then c will revolve with a velocity $v \cos b$ and move forward with a velocity $v \sin b$. If this longitudinal motion is prevented from taking place, then either the particles on the surface of c will be pushed forward or slipping will occur.

Fig. 2 is a diagram of the Mannesmann rolls by which advantage is taken of these features of skew

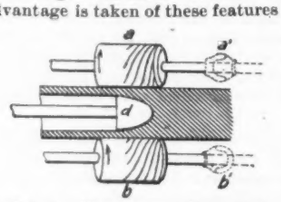


FIG. 2. Mannesmann Skew Rolls.

gear motion. In place of the thin wheel, a, Fig. 1, of the friction gearing, steel rolls, a and b, Fig. 2, are employed which have spiral threads cut in their surfaces in order to increase the friction. The heated billet is placed between these rolls, which have guides so arranged that little lateral motion of the rod is possible. If the rolls are now set in motion the billet will revolve with a velocity of $v \cos b$ and advance with a velocity $v \sin b$. The rolls, however, have their ends nearest the heating oven from which the rods are taken, cut into a conical form and placed so close together that the billet must be slightly flattened before it reaches the roll proper. A shoulder is thus formed which presses against the conical surface just mentioned and retards the longitudinal motion of the rod as a whole. The result is that the particles on and near the surface are pushed forward quicker than the remaining parts and a cup-like recess is formed in the end of the rod. As the rolls keep on moving, the hot material will be pulled from the inside of the rod and pushed forward in the form of a tube, as shown by the dotted lines in Fig. 2. The process takes place in a very short time. Great rapidity must be insured in the work, for the metal would otherwise become too cool to manipulate before the whole bar had passed the rolls. If an observer stands before the rolls, the rod at first looks like a bright dot, which almost immediately becomes a fiery circle; then the red hot tube rolls out on the pavement as a coarse wire billet comes from the wire rolls. The inside of the tube is fairly smooth.

If the shoulder was not cut on the rolls or the latter were not pressed close enough together there would be no tube formed; the billet would run through the mill with little or no change. This fact is utilized in rolling a tube with one end closed. All that is necessary is to slightly point one end of rod. The rolls have no hold of the part where the section has been diminished, and hence no tube will be formed at this place. If both ends of a bar are pointed, an apparently miraculous result follows—a hollow beam is formed, the metal being forced apart so as to form a large vacant space in the center, very much larger than the original mass, by force applied from the outside only.

This should apparently result in forming a vacuum within, since there is no way for the air to enter through the solid metal, but the actual result is to us one of the most curious recorded in physics. Prof. FINKENER has analyzed the gas found in the cavity, and found that it was 99% pure hydrogen at a pressure of approximately $\frac{1}{10}$ of an atmosphere! The presence of the hydrogen is explained by the fact that there is generally more or less of it "occluded" in all iron and steel.

This method of rolling is occasionally inconvenient and another process is then employed. The roll are not so close together and a mandril s, Fig. 3

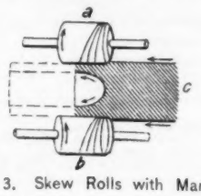


FIG. 3. Skew Rolls with Mandril.

is placed against the advancing rod. The metal is forced over the mandril head, and a tube is thus formed. In this way tubes of any thickness can be made.

By means of a modification of these rolls, shown in Fig. 4, a small tube may be rolled into one of

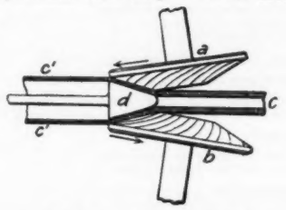


FIG 4. Enlarging Rolls.

much greater diameter. The rolls are truncated cones with very fine spiral threads for increasing the hold on the metal on their surfaces. They are driven at the same speed in opposite directions, thus revolving and pushing forward the tube c. The mandril d is shaped in such a manner that the walls of the tube c are expanded and leave the machine in the form of a much larger tube c'.

The power required to produce the tubes is very large, varying from 2,000 to 10,000 H. P., according to the dimensions of the tube. Since this power is only needed for a short time (it takes only 30 to 45 seconds to convert a bar 10 to 12 ft. long and 4 in. in diameter into a tube), and then some time elapses before the next bar is ready, an engine of 1,200 H. P. provided with a large fly wheel for storing the energy will supply power enough for one set of rolls. These fly-wheels are so large and run at such great speeds that the ordinary method of constructing them cannot be followed. A wheel at the Mannesmann Works, made in Komotau, Hungary, in the usual manner, broke at a tangential velocity of 125 ft. per second. The fly-wheels designed to hold at more than double this speed consist of a cast-iron hub to which two steel discs, 20 ft. in diameter, are bolted; around the circumference of the wheel thus formed 70 tons of No. 5 wire are wound under a tension of 50 lbs. In the Mannesmann Works at Landore, Wales, such a wheel makes 240 revolutions a minute, corresponding to a tangential velocity of 171 miles an hour.

The great strength necessary in every part of the rolling machinery and the swiftness with which all motions must be made, compelled the inventors to devise a great number of new couplings, gears and similar driving machinery, the details of which have not yet been made public.

The process itself, however, is a very successful one, not only in the forms but in the qualities of metal produced. The following tables give the results of a series of tests on Mannesmann and ordinary wrought iron lap-welded tubes.

TABLE I.—*Mannesmann Steel Tubes.*

External diameter of the tubes before turning. 4½ in.
Length over all ..... 1 ft. 5½ in.
Length between shoulders ..... 10 in.

	External diameter, ins.	Internal diameter, ins.	Thickness, ins.	Area, sq. ins.	Ultimate strength, tons per sq. in.
A	4.45	4.36	.045	.622	20.9
B	4.47	4.33	.07	.939	25.53
C	4.5	4.31	.095	1.315	27.7
D	4.565	4.325	.12	1.666	....

NOTE.—The testing machine was not strong enough to have any effect on tube D.

A strip cut parallel to the axis of a tube, similar

to those used in the above tests, gave the following results when tested: Breaking strain per square inch, 35 tons; elongation in 8 ins., 25%; contraction of area, 54.2%.

TABLE II.—*Mannesmann Steel Tubes.*

External diameter before turning..... 3¼ in.
Length over all..... 1 ft. 5½ in.
Length between shoulders..... 10 in.

	External diameter, ins.	Internal diameter, ins.	Thickness, ins.	Area, sq. ins.	Ultimate strength, tons per sq. ins.
A.....	3.31	3.2	.055	.600	18.6
B.....	3.3	3.18	.06	.611	25.3
C.....	3.36	3.19	.085	.871	28
D.....	3.29	3.03	.13	1.10	34.9

NOTE.—B, C and D of this set failed without fracture.

A strip cut parallel to the axis of a tube, similar to those used in the above tests, gave the following results when tested in tension: Breaking strain per square inch, 37 tons; elongation, 20% in 8 ins.; contraction of area, 42.5%.

TABLE III.—*Wrought Iron Tubes.*

External diameter of tubes before turning.. 3⅞ in.
Length over all..... 1 ft. 5½ in.
Length between shoulders..... 10 in.

	External diameter, inches.	Internal diameter, inches.	Thickness, inches.	Area, sq. in.	Ultimate strength, tons per sq. in.
A.....	3.63	3.55	.035	.399	17.54
B.....	3.7	3.36	.07	.802	18.08
C.....	3.73	3.53	.10	1.14	19.98
D.....	3.78	3.54	.12	1.38	20.9

For the purpose of comparing the ultimate tensile strength of a Mannesmann and lap-welded boiler tube, two small bottles made of such tubes were filled with boiling water and then placed in a freezing mixture. The lap-welded bottle burst, but the other remained intact.

Another Mannessmann tube, 1 in. in internal diameter and $\frac{1}{16}$-in. thick, was subjected to an internal pressure of 3.6 tons per sq. in. at the Siemens Bros.' works at Chalton without injury. When removed from the testing apparatus it was distinctly warm to the touch, but otherwise exactly the same as before the test. The power of resisting great internal pressure makes the tubes particularly well adapted for vessels made to contain gases at high pressure.

At the Mannesmann Works at Komotau, Hungary, more than 600 tons or 25 miles of 3-in. and 4-in. tubes averaging ¼ in. in thickness have been successfully tested to a pressure of 2,000 lbs. per sq. in. These tubes were intended for a high-pressure water main in a Chilian nitrate district. But the severest test to which the Mannesmann tube can be subjected is the process of manufacture itself. If the metal is homogeneous throughout and well melted, well rolled and carefully heated, it makes a practically perfect tube; but if there is any flaw in the bar, or if the furnace man has been careless in the heating, then the Mannesmann rolls reject that bar, by refusing to make a tube of it, more surely than a human inspector would do.

This great tensile strength is probably due to the fact that, in addition to being much more worked than most metal, the fibres of the metal run spirally, as has been frequently proved by microscopic examination. The result of this increased strength is a great diminution in the weight of the tubes. While cast iron tubes will hardly stand more than 200 lbs. per sq. in., and welded tubes are not safe above 1,000 lbs. per sq. in., the Mannesmann tube easily withstands 2,000 lbs. per sq. in., as already mentioned. The length up to which they can be readily made is shown by the fact that a coil of 3-in. tube 70 ft. long was made recently.

Prof. REULEAUX, who undoubtedly ranks as the greatest mechanical engineer in Germany, closed his address thus:

It is undoubtedly true that we have in the Mannemann process an epoch-making invention; it is certain to bring about a great change in rolling mills; it has, indeed, already had a deep influence on rolling processes. The energy and untiring perseverance with which the inventors have worked out their plans and put them into actual use deserves our warmest appreciation.

Dr. WEDDING has made some microscopical examinations of tubes made by this process and has found that with a very low magnifying power the metal shows a distinct spiral structure. The tubes of cast steel have a number of extremely minute gas bubbles which wind through the metal, following closely the direction of the fibers. The presence of these spaces does not appear to materially affect the strength of the material since the tests show at least double the strength of similar wrought iron tubes.

In the examination of the gases found within the cavity of the beam, made by Prof. FINKENER, of the Royal Test Works, at Berlin, as noted above, the cavity contained 7.53 cu. ins., and was filled with a gas which had a volume of .55 cu. ins. at a barometric pressure of 29.922 ins. and a temperature of 32° Fahr. This gas was found to consist of 99% hydrogen and 1% nitrogen. The fact that it had not diffused since the tube was rolled, although nearly pure hydrogen, clearly shows the density of the metal.

In Figs. 5 and 6, are shown two interesting products of the Mannesmann rolls. The first is a beam

FIG. 5. Mannesmann Rolled Beam of Constant Strength.

of constant strength formed by rolling a tube with the thickness of the metal increasing from the ends to the center. This is done by making the central parts of the billet from which the tubes are rolled of a less section than the end portions. After the tube has been thus prepared, it is passed through finishing rolls, which give it the required shape.

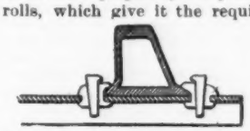


FIG. 6. Section of Mannesmann Rail.

Fig. 6 represents a Mannesmann rail section, formed by rolling a tube in proper finishing rolls. The German military authorities are experimenting with these tubes for gun barrels, and with considerable success, it is said. The process as a whole must be admitted to be one of the most notable triumphs of the ingenuity of man.

Irrigation in Wyoming.

The following data regarding irrigation in Wyoming are abstracted from the Second Annual Report of ELWOOD MEAD, Territorial Engineer. The period covered in the report is from April 1, 1888, to Nov. 30, 1889.

The rapid development of irrigation in Wyoming during the last 10 years is largely the result of a local demand for agricultural products, caused by the grazing industries of the State. The climate is such that it is necessary to feed cattle during a part of the year, and food products, both for the cattle and the increasing population can be grown in any considerable quantities only by irrigation. At the time of the report Wyoming was the youngest of our territories, but, notwithstanding this, it stood third in the area of irrigated land and in the number and mileage of irrigation canals.

By an act of the Legislature of 1886 Wyoming was divided into eight water districts, to which one district has since been added. These districts comprise nearly the whole of Wyoming, the unorganized portions being the northern part of Uinta Co. and a strip between the third and fourth districts.

The location and extent of these districts, together with the streams supplying water for irrigation, are given in the report, but that data will not be presented here as it would not be readily intelligible without a map and none is given in the report.

Suffice it to say that the districts conform to natural watersheds and to areas which it was thought one water commissioner could supervise. Such commissioners have been appointed by the Governor for each district, being first recommended by the county commissioners. They have general supervision of the distribution of water within their districts, but may not be employed more than 50 days in the year.

The total area of Wyoming is stated in the report as 61,734,297 acres, of which 2,106,181 acres, or slightly over 3%, are reported as under irrigation. The actual area under irrigation is somewhat larger, as of 2,750 ditches recorded, the acreage watered by 670, or nearly one-fourth of the whole, is not stated. It is probable that many of these last are small ditches. The total length of the 2,033 ditches, the mileage of which is known, is 4,798 miles, or an average length of 2.06 miles. The average number of acres watered by the 2,080 ditches, for which the area irrigated is stated, is 1,013, therefore, the approximate acreage irrigated per mile of ditch is 492.

The report states that "the majority of the irrigation works of the territory are owned by parties owning the land they reclaim, and while small, are, as a rule, substantially and well built."

A great fault in the lateral ditches is that they follow contour lines without regard to the consequent increase in length, loss of velocity, and greater evaporation.

Among the large irrigation works in Wyoming, mention is made of the Wyoming Development Canal, which waters 58,000 acres and has cost $485,000; of the Pioneer and the Boughton Canals, the first watering 50,000, and the latter 10,000 acres, and each having cost $50,000. These three canals take their water from the Laramie River, as does the Brown Ditch, which waters 10,000 acres.

The works of the Wyoming Development Co., the owners of the first-named canal, are said to rank with the most important irrigation works of the country. Water is taken from the Laramie River about 50 miles from the area irrigated, first passing through a mountain by means of a tunnel 2,380 ft. in length. The tunnel discharges the water diverted into a stream parallel to the river, from which main canals, with a combined length of 100 miles, distribute the water. The canal was completed in 1886, but owing to complications regarding land titles it has been used but little.

The Platte, Green, Big Horn and Snake rivers have as yet hardly been drawn upon for irrigation, although they have the greatest discharge of any within the limits of Wyoming. Important canals have been projected in connection with the Platte and Green rivers.

The report devotes less than a page to hydraulic mining in Wyoming. Reference is made to the Christiana Lake Mining Works, on Rock Creek, a tributary to the Sweetwater River. The water used by these works in placer mining is brought, in part, from reservoirs on the summit of the Wind River Mountains, at an elevation of 10,250 ft. These works have, in addition to their canals, 31 flumes, with an aggregate length of two miles. One of the flumes is 75 ft. high.

A record of the water used in irrigating 123.7 acres of oats and 7 acres of potatoes showed a duty of 93.8 acres for the former and 229.5 for the latter. That is, at the rate water was used for these crops, a continual flow of water during the 123 days of May, June, July and August, the irrigating season, equal to 1 cu. ft. per second, would be sufficient to irrigate 93.8 acres of oats or 229.5 acres of potatoes.

Before making further comments on the above experiments, the fact should be emphasized that the water was measured at the place where it was used, and that no allowance was made for seepage and evaporation of the water on its passage through the main canal.

Further details of the experiments show that for the oats irrigation was employed during but 54.5 days, and the average discharge per acre during that period was 3.79 cu. ft. per second. For the potatoes water was distributed during but 36 hours, an average discharge per acre of 2.5 cu. ft. per second. The total amount of water used for the oats was 14,056,236 cu. ft. in 54.5 days, which is equivalent to an average discharge for the 123 days of the irrigating season of 1.32 cu. ft. per second. The same figures for the potatoes are a total of 323,825 cu. ft. in 36 hours, or 0.0305 cu. ft. per second of the irrigating season.

It is interesting to note the depth of rainfall and irrigation in inches for each of the months and the total for the four months, as follows:

	Apr.	M'y.	June.	July.	Aug.	Irrig'ting seas'n
For oats.						
Depth of rainfall....	0.50	3.45	3.37	1.99	0.75	10.06
Depth of irrigation..	....	....	7.236	21.936	2.124	31.296
Total.....	0.50	3.45	10.606	23.926	2.874	41,356
For potatoes.						
Depth of rainfall	0.50	3.45	3.37	1.99	0.75	10.06
Depth of irrigation..	....	....	....	12.744	....	12.744
Total.....	0.50	3.45	3.37	14.734	0.75	22.804
Differences in totals, excess required for oats.						
Total depth.....	0	0	7.236	9.192	2.124	18.552

It will be seen that no irrigation was required for either crop during the first two months, and none at all for potatoes except in July. Also that the rainfall for the period furnished about one-fourth of the water which the oats had and nearly one-half

for the potatoes, while the oats had 18.552 ins. more during the season than did the potatoes.

It is stated that corn requires less water than any other of the important crops, the range from greatest to least quantities being as follows: Native hay, tame grasses, small grain, root crops (including potatoes) and corn.

From responses to inquiries sent to leading farmers the expense of constructing the ditches and distributing works of Wyoming has been found to be about $5 an acre, making the total investment in irrigation works to near the close of 1889 about $10,000,000. Already about 400 streams are drawn upon.

During the year ending Sept. 1, 1889, the railways brought into Wyoming 35,533,800 lbs. of farm products, all of which, it is stated, could have been produced within the territory had irrigation been more fully developed. The estimated value of the products brought into the territory, but which might have been produced there, is placed at $500,000. In addition, had this produce been grown in the territory, the population required for its production would have increased the total population of the territory, and thus increased the demand for these and other products.

It will be seen from the above that Wyoming has done considerable in the way of irrigation, but that a great deal remains to be done in the future.

The Rose Hill Reservoir Embankment, Toronto, Ont.

In our issue of June 21 we showed by means of an inset several plans, sections and elevations of dams and reservoir embankments in the United States and Canada. The accompanying cross-sections of the Rose Hill reservoir embankment at Toronto, Ont., belong properly with that collection, but it was not then practicable to present them.

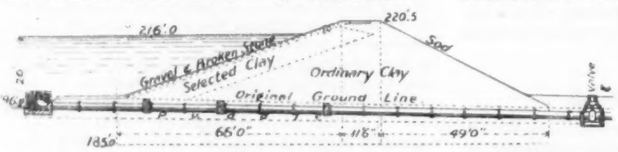


FIG. 1. CROSS-SECTION OF SOUTH BANK OF ROSE HILL RESERVOIR, TORONTO, ONT.

As will be seen by Fig. 2, the reservoir is located on the side or top of a hill. After having been in use for about three years slides occurred on the outer slope of the embankment. These were evidently caused by the character of the soil, shown in Fig. 2, and by the presence of water, probably coming from natural springs in the side of the hill. The means taken to repair the broken bank and to prevent future accidents are plainly shown in Fig. 2, while Fig. 1 shows a section of the bank at the influent pipe.

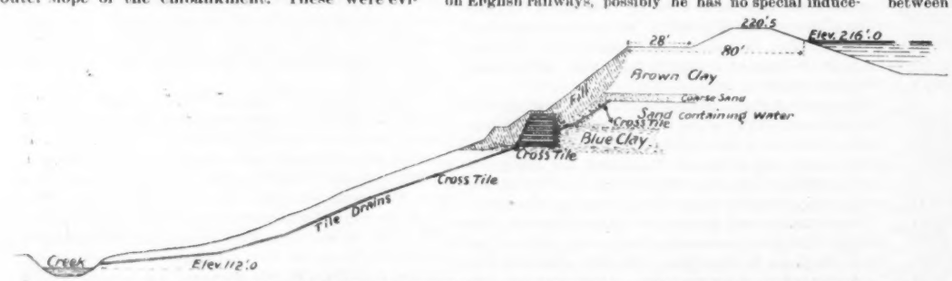


FIG. 2. SECTION SHOWING METHOD OF METHOD OF REPAIRING BREAK AND DRAINING BANK OF ROSE HILL RESERVOIR, TORONTO, ONT.

English and American Locomotives.

Contemporary journals in the United States take a good deal of interest in questions concerning the comparative efficiency of English and American locomotives. They, as a matter of course, assume that the product of American shops must be better than anything English engineers can produce. This opinion is largely based on ignorance. The journals which are most boastful really know least about the details of the subject. With the American locomotive engine they are more or less well acquainted, but they possess little or no accurate information concerning the details of the working of an English railway. We have, as our readers no doubt remember, recently endeavored to induce one of our contemporaries, the ENGINEERING NEWS, to condescend to particulars, and give the world some reasons for assuming that the American locomotive is the best in the world; and, to consolidate ideas and simplify matters, we suggested that one thing should be discussed at a time, and we proposed that the ENGINEERING NEWS should begin with boilers and fuel economy. Our contemporary promised, in reply, that we should have the facts and arguments for which we asked; but months have passed, and he has preserved a strict and possibly judicious silence. Then the *Railroad Gazette*, tired of waiting, took up the cudgels for the American engine; but it eschewed facts and adhered to opinions. Now, we did not and do not want any expression of opinions; we want facts; and these, it would appear, are not to be had. The last number of Mr. FORNEY'S paper, the *Railroad and Engineering Journal*, contains a very amusing article summing up the whole controversy, so far as it has gone; but neither does it add anything to the available store of facts. At this rate it is evident that no progress can be made. It fortunately happens that, in the United States, the locomotive superintendents hold periodically what is known as the Master Mechanics' Convention, and it is only necessary to peruse the "Proceedings" to acquire a great deal of useful information concerning American railway practice. Of course this information is diffuse, and in some senses contradictory; but it enables us to speak with more certainty on American railway practice than would be possible if it did not exist; and for this, and other reasons, we know more about American locomotives thon our contemporaries know about our engines. We are, however, quite willing to admit that we want fresh light thrown on dark places, and we propose to make certain statements concerning American boiler practice which we believe to be correct. Any of our contemporaries who contradict us we shall expect to adduce proof, not mere expressions of opinion, which, however valuable otherwise, are for the present purpose of no use.

We assert that American locomotives burning bituminous or semi-bituminous coal do not evaporate more than from 5 to 7 lbs. of water per pound of coal, and that English locomotives burning bituminous or semi-bituminous coal evaporate from 7 to 10 lbs. We draw these facts from the results of numerous carefully-made experiments on different American and English roads, and we do not think that their truth can be disputed. The question then arises, why should the American locomotive boiler be so bad? Various reasons suggest themselves to us, and we shall set these forth for the consideration of our contemporaries. In the first place, then, we venture to assert that the American fireman is not as skillful as the fireman found on English railways. Possibly the former has a soul above firing; possibly he lacks the training imparted on English railways, possibly he has no special inducement to save coal. On these points we can express no decided opinion. Again, it is possible that American coal is not as good as English or Welsh coal; but this we doubt, because our American friends always tell us that the best coal in the world is used on American railways—in fact that all American coal is very good indeed. But even if the coal is not quite so good as the Americans—slightly prejudiced, perhaps—would have the world believe, it is impossible to fancy that it is 30 to 40 per cent. worse than English coal. In Belgium the coal used is really very poor stuff—dross—burned on enormous grates, but it evaporates more than 5 lbs. of water per pound; in fact, so far as we are aware, it is not easy to find any locomotive boilers with so small an economic efficiency as the American boiler, until we resort to Austrian lignite burning engines, and even these manage to get 5 lbs. of steam for each pound of brown coal put on their grates. After every allowance has been made, then, for the coal and the fireman, it seems to be clear that the American boiler is not quite what it ought to be. Its most prominent defects must be sought in the fire box. It is not, we suppose, that American engineers do not know how to burn coal to the best advantage, but that they will not do it, for some reason to us inscrutable. It has long been known in this country that to get the full value out of coal there must be a brick arch in the fire box. In railway work, as in other things, it is impossible to avoid the influence of ruling conditions. It is a condition that if a brick arch is used, the fire box must be of copper; because, if a fair amount of work is to be got out of an engine, as little time as possible should be spent in washing out the boiler. Now, if the engine has a copper fire box, the boiler may be blown out while the brick arch is still hot, and no harm will be done; but if the fire box is of steel, it will certainly be cracked if the boiler is emptied before the fire-brick arch is cold. But American Engineers will not use copper boxes, preferring steel, and to avoid delay in washing out they give up the brick arch. We do not desire to assert that the proportions of American boilers are bad; but we do assert that the absence of the brick arch tends very powerfully to make them wasteful of fuel. This is a point to which we desire to direct the special attention of our contemporaries. We believe that they will find, on inquiry, that what we have said is substantially accurate, and that American engineers will admit, not only that the absence of the brick arch leads to waste of fuel, but that they accept the waste rather than submit to use a copper fire box. [The article then notes some brick arch experiments on the Paris, Lyons & Mediterranean Ry. showing 12 per cent. economy, and continues:] American engineers use an enormous extended smoke box to hold unconsumed fuel carried through the tubes. In this country we need nothing of the kind, because of the brick arch. With boilers of the proportions used in England we have no doubt that the economy secured by the arch is much greater than 12%. It may perhaps be said that, after all, the cost of coal is a secondary matter; but even if we admitted this which we do not—there are many other things to be taken into consideration. Let us, for example, suppose that of two engines, alike in other respects, one burns 33⅓ more coal than the other. Let us call the first *A* and the second *B*. It is clear that if both engines exert the same power, the wear and tear of the boiler, fire box, grate bars, and fireman will be at least one-third greater in the case of *A* than in the case of *B*. Furthermore, let us assume that the boilers are in both cases worked up to their utmost capacity; then *B* will be able to draw a 33 per cent heavier train than *A*. To get more work out of *A* a smaller blast nozzle must be used to get a sharper draught, and this means more back pressure. It must never be forgotten that the steaming capacity of a locomotive is often as important as its economy, and the more water that a pound of coal can convert into steam the greater becomes not only the economical, but the actual efficiency; always provided, of course, that economy is not secured by making the draught suffer, a condition, which, however, we need scarcely have named, as the brick arch does not hinder the draught.

Our contemporaries appear to find so much difficulty in dealing with what we say concerning American locomotives, that we do not wish to worry them by raising any more questions just now concerning points of difference between American and English practice. We have said enough, we think. As the matter stands now, we assert that the American boiler is not, as a matter of fact, as economical as the English boiler by 25 to 30 %., or even more This fact is, we think, not disputed. Secondly, as to the reasons why, we speak with less certainty, and shall be glad to hear what our contemporaries have to say in the way of explanation. We have given our notions on the subject, based on statements made by American engineers in American technical journals and the "Transactions" of scientific societies. Perhaps our contemporaries will show that the American locomotive is better without a brick arch than with one, that it is better with a steel box than with a copper box. When we have heard what they have to say on this point we can go on to discuss other matters, such as questions of workmanship, the design of various details, and so on; but for the present we would ask our contemporaries to concentrate their attention on the broad fact that the American boiler is, from the economical-efficiency point of view, deplorably bad.—*The Engineer.*

A New Method of Sewer Ventilation.

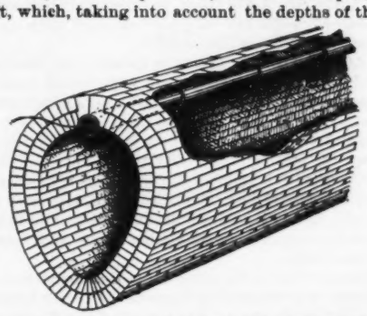
The London *Sanitary Record* describes a new system of sewer ventilation invented by Mr. ARCHIBALD FORD, Assoc. Mem. Inst. C. E., and Mr. E. G. WRIGHT, of Portsmouth, England. The system is now being carefully tested on a section of the Portsmouth sewers by Mr. MURCH, the Borough Engineer.

The essence of the invention consists in the provision of a separate air duct at the upper part of the sewer, which has openings to the sewer at intervals. In this manner the friction of the flowing sewage on the air current is obviated, and the latter is found to be under positive control, no matter what the volume or velocity of the sewage flow, or what the

external winds may be. The only connections to the outer air are at the uptake and downtake shafts. Experiments extending over three months show that the only effect of winds blowing in any direction was to increase the flow of air in the ventilating pipe.

The mode in which this system has been applied to a section of the Portsmouth main sewer is shown in the accompanying engraving. The sewer is 4 ft. in diameter and is laid about 10 ft. underground. The "special air passage" is formed of galvanized steel tubes, 5½ ins.in diameter and 2 ft. 6 ins. long, which are fastened to the crown of the sewer and are open to it at every joint.

The section of sewer experimented upon is 100 yds. long. At its lower end the air passage is connected to an ordinary grating by a "down-take" shaft. At the upper end the air passage opens into a low brick ventilating shaft. To make the flow of air positive without relying solely on the difference in the heights of the downtake and uptake shafts, a small water jet is used in the down take shaft. Careful experiments show that with a jet consuming 23 galls. of water per hour a steady current of air is maintained in the downtake shaft at velocities varying with the pressure in the water main from 330 to 390 ft. per minute. This is equivalent to from about 4,000 to 4,500 cu. ft. of fresh external air passed regularly and continuously into the air passage, and distributed thereby along the sewer every hour, diluting the sewer air and forcing it in calm weather in its diluted state, at a rate varying from 1,716 to 2,492 cu. ft. per hour, out of the uptake shaft, which, taking into account the depths of the



sewage (which has varied when the experiments were taken from 15 to 30 ins.), represents approximately—and with little variation—the entire change of the air of the 100 yds. of sewer once in every hour.

The records, which extend over several months, show that the best results have been obtained in the most windy weather. Except in the calmest weather, the system acted without resort to the water jet. The consumption of water is, however, quite moderate, especially as the inventors show that the water can often be further utilized for flushing the sewers by collecting it in automatic flushing tanks. The results at Portsmouth show that for each cu. ft. of water consumed, 1,246 cu. ft. of air can be introduced into and carried for a considerable distance along the air passage. In the application to small sewers it is said that less water would be sufficient.

The use of a water jet as a ventilating fan is a novelty of much importance. While it is certainly a wasteful way to utilize power, it has other manifest advantages for work of this sort which may very likely offset its want of economy.

It is suggested that by making the chimney high enough or passing the escaped sewer gas through heat and flame in the chimney, the effluent vapors could be made perfectly harmless.

A complete installation of the system is soon to be completed under direction of Mr. FORD on an estate at Cosham, Hants. Here a small pipe sewer is to be used, with the special air passage made as an integral part of the pipe, and communicating with the main sewer at frequent intervals. The plant will be so arranged as to secure a continuous flushing of the sewer with fresh air every hour and with water about three times a day.

The chief advantages claimed by the inventors over ordinary ventilating methods are the protection of the fresh-air inlet from the escape of noxious gas from the sewer, the prevention of a reversal of air current in the drains and soil-pipes on discharge from the house fittings, and also the prevention of the siphonage of traps.

Statistics showing the Progress and Prospects of Railway Construction in the Northwestern States.

[WITH MAP NO. 27.]

ILLINOIS—Existing Roads.

Alton Terminal.—Track laid in 1889, in city of Alton, 1.5 miles.

Centralia & Chester.—Track laid in 1889, Sparta to Coulterville, 8 miles. Partly graded, Coulterville to Centralia, 33 miles. Projected, Centralia to Altamount, 45 miles; sparta to Chester, 20 miles.

1. *Chicago & Northwestern.*—Track laid since Jan. 1, 1890, Montrose to North Evanston, 7.3 miles.

2. *Chicago & Ohio River.*—Surveyed, Sidell to Fair mount, 9.5 miles. Projected, Olney to Paducah, Ky., 130 miles.

3. *Chicago, Milwaukee & St. Paul.*—Under survey, Shullsburg, Wis., to Galena, Ill., 20 miles.

Chicago, Peoria & St. Louis.—Track laid since Jan. 1, 1890, Litchfield to Edwardsville, 26 miles. Under construction, Edwardsville to East St. Louis, 22 miles.

4. *Elgin, Joliet & Eastern.*—Track laid in 1889, Spaulding to Waukegan, 40.7 miles.

Grand Tower & East Cape Girardeau.—Track laid in 1889, Grand Tower to East Cape Girardeau, 28 miles.

5. *Illinois Central.*—Partly graded, Chicago, Burlington & Quincy R. R. crossing to Chicago, 8.6 miles.

Indiana & Illinois Southern.—Projected, point 12 miles west of Newton to East St. Louis, 115 miles.

6. *Indianapolis, Decatur & Western.*—Projected Decatur to Beardstown, 81.7 miles.

Kaskaskia, St. Elmo & Southern.—Projected, Altamont to Metropolis, 15.8 miles.

Louisville, Evansville & St. Louis.—Track laid in 1883, Mt. Vernon to Walnut Hill, 16 miles. Track laid since Jan. 1, 1890, Centralia to Belleville, 48.9 miles.

7. *North and South of Illinois.*—Projected, Springfield to Eureka, 72 miles; Alhambra to East St. Louis, 28 miles.

9. *Pawnee.*—Track laid in 1889, Pawnee to St. Louis & Chicago Ry. junction, 5 miles. Under survey, end of track east 5 miles. Projected, 10-mile post to Auburn, 85 miles.

10. *St. Louis, Alton & Springfield.*—Track laid in 1889, Newbern to Alton, 14 miles. Partly graded, Bati's to Springfield, 14 miles. Surveyed, Alton to Venice, 20 miles.

St. Louis & Chicago.—St. Louis & Peoria R. R.—Track laid in 1889, Mt. Olive to Alhambra, 14 miles.

Projects and Surveys.

Belleville & St. Louis.—Projected, Belleville to East St. Louis, 8 miles. President, John S. Hill, East St. Louis; Chief Engineer, Lewis Grauer, Belleville.

Cairo & Northwestern.—Projected, Cairo to East Cape Girardeau, 40 miles. President, Chas. A. Patiee; Chief Engineer, Geo. W. Morse; both of Cairo.

Chicago & New Orleans.—Projected, Shumway to Paducah, 152 miles. President, Geo. A. Sanders; Chief Engineer, Chas. Hansel; both of Springfield.

11. *Danville, Chicago & Northern.*—Projected, Tilton to Strawn, 85 miles. President, John McNulty; Chief Engineer, Chas. Hansel; M. A. McDonald, Danville.

Little Wabash.—Projected, Effingham to Carmi, 75 miles. Edward Austin, Effingham; T. Gould, Bible Grove.

12. *Mount Auburn & Taylorville.*—Projected, Mount Auburn to Taylorville, 16 miles. President, John B. Matthews, Mount Auburn; John G. Dunnon, Taylorville.

13. *Pana & Roodhouse.*—Surveyed, Pana to Roodhouse, 70 miles. President, J. C. Essick, Pana.

14. *Paxton & Eastern.*—Projected. Paxton to Indiana State line, 40 miles. Charles Bogardus, Springfield.

14½. *Quincy, Keokuk & Chicago.*—Projected, Quincy to Niota, 50 miles. C. A. McLaughlin, Warsaw; Jas. M. Bishop, Quincy.

15 *Rochester, Rensselaer & St. Louis.*—Under survey, Gilman to Rochester, Ind., 100 miles. President, John K. Lee, St. Louis, Mo.; Chief Engineer, Burr P. Noland; Secretary, John T. Holsinger, both of Winamac, Ind.

St. Louis, Chester & Birmingham.—Surveyed, East St. Louis to Grand Tower, 90 miles. Chief Engineer, V. S. Dobbins, Erie, Pa.; H. M. Pollard, St. Louis, Mo.; S. Dwight Eaton, Burlington, Ia.

St. Louis, Venice & Alton.—Under survey, Alton to East St. Louis, 20 miles, H. M. Needles, Belleville; J. K. Ewing, East St. Louis.

16. *Springfield & Hillsboro.*—Surveyed, Springfield to Donnellson, 59 miles. President, J. M. Stark, Pawnee; Chief Engineer, Jas. E. Burtle.

Total.—Track laid in 1889, 127.2 miles. Track laid since Jan. 1, 1890, 82.2 miles. In process of construction, 77.6 miles. Surveyed or under survey, 308.5 miles. Projects of some promise, 1,200.7 miles.

WISCONSIN.—Existing Roads.

17. *Abbotsford & Northeastern.*—Track laid in 1889, Abbotsford to Athens, 15 miles.

18. *Chicago, Milwaukee & St. Paul.*—Under construction, Necedah to Remington, 19 miles; Lynn north, 4 miles. Projected, end of grade to Superior, 160 miles.

19. *Chicago, St. Paul, Minneapolis & Omaha.*—Under construction, Neillsville to Marshfield, 23.15 miles.

20. *Goodyear, Neillsville & Northern.*—Track laid in 1889, Goodyear to Saddle Mound, 5 miles. Projected, Saddle Mound to Neillsville, 20 miles. President, D. O. Goodyear, Tomah.

21. *Kickapoo Valley & Northern.*—Under contract, Wauzeka to Wilton, 80 miles. President, E. I. Kidd, Prairie du Chien.

22. *Milwaukee & Northern.*—Track laid in 1889, Oconto to Stiles Junction, 12 miles.

23. *Milwaukee, Dexterville & Northern.*—Track laid in 1889, Newtown to Lynn, 10 miles.

24. *Milwaukee, Lake Shore & Western.*—Track laid in 1889, Wolf River Branch, 1.5 miles; end of track to Van Buskirk, 40.7 miles; in city of Hurley, 0.7 miles. Under survey, Wausau to Marshfield, 41 miles.

25. *Milwaukee, Menominee Falls & Western.*—Track laid in 1889, Granville to Sussex, 10.5 miles.

26. *Port Edwards, Centralia & Northern.*—Under contract, Port Edwards to Centralia, 32 miles. President, J. E. Nash; Chief Engineer, E. Baldwin; both of Centralia.

27. *Sault Ste. Maria & Southwestern.*—Track laid in 1889, Osseo to Eleva, 14 miles. Partly graded, Osseo to Mondovi, 23 miles. Projected, Fairchild to Rhinelander, 115 miles; Mondovi to Alma, 20 miles. President, N. C. Foster, Fairchild; Chief Engineer, James McIntyre.

28. *Wisconsin Central.*—Under construction, north of Glenwood north 12 miles. Under survey, Marshfield to Glenwood, 17.5 miles.

Projects and Surveys.

29. *Burlington, Stillwater & Northern.*—Projected, St. Croix Falls to Pepin, 125 miles. John A. Swanson, G. Holcombe; both of Houlton.

30. *Chicago, Baraboo & Northern.*—Under survey, Jefferson to Kilborne, 70 miles. President, Frank Avery; Secretary, Chas. Junge; both of Baraboo.

31. *Chicago, Lake Geneva & Pacific.*—Projected, Lake Geneva to Jefferson, 40 miles. President, W. A. P. Noble; Secretary, Chas. M. Morris; both of Madison.

32. *Delavan, Lake Geneva & Chicago.*—Projected, Delavan to Lake Geneva, 10 miles. W. G. Weeks, F. C. Smith; both of Delavan.

33. *Eau Claire & Mississippi River.*—Projected, Eau Claire to Winona, 66 miles. President, R. F. Wilson; Chief Engineer, C. E. Bissell; both of Eau Claire.

34. *Freeport, Ironton & Mauston & Northern*—Projected, Dexterville to Lone Rock, 60 miles. President, Jeff. I. Heath; Vice-President, F. Winsor; both of Mauston.

35. *Kewaunee, Green Bay & Western.*—Surveyed, Ft. Howard to Kewaunee, 34 miles. President, W. J. Abrams; Chief Engineer, S. B. Fisher; both of Green Bay.

36. *La Crosse, Black River Falls & Eastern.*—Surveyed, La Crosse to Black River Falls, 50 miles. Projected, Black River Falls to Antigo, 100 miles. President, Hugh H. Price; Chief Engineer, W. D. Henderson; both of Black River Falls.

Milwaukee Belt & Terminal.—Under survey, in and around city of Milwaukee, 50 miles. Pres dent, Frederick Kalbfleisch, 36 New St., New York City; Chief Engineer, Robt. P. Vandusen, Milwaukee.

37. *Sheboygan & Southwestern.*—Projected, Sheboygan to Waldo, 15 miles. Chief Engineer, F. Kirchman; Jas. Wallman; both of Sheboygan.

38. *Waukesha, Pewaukee, Oconomowoc & Western.*—Under survey, Waukesha to Oconomowoc, 22 miles. Chief Engineer, E. M. Spaulding; Chas. L. Classen; both of Milwaukee.

39. *Wisconsin Southern.*—Projected, Shullsburg to Rutledge, 30 miles. Thos. Whiting; Henry L. Lee; both of Chicago.

Total.—Track laid in 1889, 109.4 miles. In process of construction, 193 15 miles. Surveyed or under survey, 294.5 miles. Projects of some promise, 761 miles.

MICHIGAN.—Existing Roads.
(*Lines within limits of maps only.*)

40. *Escanaba, Iron Mt. & Western.*—Under construction, Escanaba to Iron Mt., 100 miles. Chief Engineer, G. M. Willis, Iron Mt.

Hecla & Torch Lake.—Track laid in 1889, Hecla to Red Jacket Mine, 1 mile.

22. *Milwaukee & Northern.*—Track laid in 1889, Adventure Creek to D. S. S. & A. R. R., 26 miles.

Projects and Surveys.

41. *Iron Range & Champion.*—Surveyed, Huron Bay to Champion, 35 miles. Chief Engineer, Milo Davis, Detroit.

Total.—Track laid in 1889, 27 miles. In process of construction, 100 miles. Surveyed or under survey, 35 miles.

MANITOBA and NORTHWESTERN PROVINCES.—Existing Roads.

Canadian Pacific.—Qu'Appelle, Long Lake & Saskatchewan R. R.—Track laid in 1889, end of track north 90 miles. Track laid since Jan. 1, 1890, end of track to Saskatoon, 46.4 miles. Under construction, Saskatoon to Prince Albert, 90 miles. Brandon-Souris Branch.—Track laid in 1889, Kinmay to Souris, 17 miles. Track laid since Jan. 1, 1890, Souris southwest, 10 miles. Under construction, end of track southwest, 40 miles. Barnsley Branch.—Track laid in 1889. Barnsley to Carmen, 8 miles. Southwestern Branch.—Under construction, Glenboro to Souris, 50 miles. Pembina Branch.—Projected, Deloraine to Alameda, 90 miles.

Great Northwest Central.—Track laid in 1889, Brandon northwest, 50 miles. Under contract, 50-mile post to 150-mile post, 100 miles. Under survey, 150-mile post to Battleford, 300 miles.

Manitoba & Northwestern.—Graded, Saltcoats to Yorktown, 17.5 miles. Under survey, Yorktown north west, 33 miles. Projected, end of survey to Prince Albert, 192.5 miles.

Northern Pacific & Manitoba.—Track laid in 1889, Winnipeg to Portage la Prairie, 52 miles. Morris-Bandon Branch.—Track laid in 1889, Morris to end of track, 130 miles. Track laid since Jan. 1, 1890, end of track to Brandon, 5 miles.

42. *Port Arthur, Duluth & Western.*—Track laid in 1889, Fort William to Kamanistiqua, 15 miles. Surveyed, end of track to International boundary, 70 miles; branch to Kakabeka Falls, 10 miles.

Projects and Surveys.

Calgary & Edmonton—Under survey, International boundary to Edmonton, 350 miles. Chief Engineer, Alex. Stewart, Calgary, N. W. T.

Manitoba & Southeastern.—Surveyed, Winnipeg south, 30 miles. Projected, 30-mile post to International boundary, 70 miles. President, Alex. Logan; Chief Engineer, Alex. Stewart; both of Winnipeg.

North Western Junction & Lake of the Woods.—Projected, Portage la Prairie to Lake of the Woods, 175 miles. Alex. Mutchmor, 104 Sparks St., Ottawa, Ont.

Winnipeg & Hudson Bay.—Projected, Winnipeg to Saskatchewan River, 300 miles.

Winnipeg & Southeastern.—Projected, Winnipeg International boundary, 100 miles.

Total.—Track laid in 1889, 382 miles. Track laid since Jan. 1, 1890, 63.4 miles. In process of construction, 793 miles. Projects of some promise, 917.5 miles.

MINNESOTA.—Existing Roads.

1. *Chicago & Northwestern.*—Partly graded, Kasson to Mantorville, 3 miles.

43. *Chicago, St. Paul & Kansas City.*—Track laid in 1889, Eden to Wasioja, 4 miles.

44. ***Duluth & Winnipeg.***—Track laid in 1889, end of track to Mississippi River, 50 miles. Track laid since Jan. 1, 1890, end of track northwest, 30 miles. Under construction, end of track to International boundary, 126 miles. Chief Engineer, W. H. Knowlton, Cloquet.

45. ***Duluth, Crookston & Northern.***—Track laid in 1889, Crookston to Fertile, 22.5 miles.

Duluth Incline.—Track laid in 1889, Bay View to West Duluth, 3 miles.

46. ***Duluth, Red Wing & Southern.***—Track laid in 1889, Goodhue to Zumbrota, 9 miles. Projected, Red Wing to Duluth, 150 miles; Zumbrota to Albert Lea, 57 miles.

47. ***Great Northern.***—Under construction, Crookston to Keystone, 16 miles.

Minnesota & Southeastern.—Track laid in 1889, on main line, 1 mile; on branches, 8 miles.

48. ***Northern Pacific.***—Track laid in 1889, Little Falls to Staples, 33.6 miles.

49. ***Winona & Southwestern.***—Track laid in 1889, Bear Creek to Utica, 10 miles. Under construction, Utica to Stewartsville, 33 miles. Under survey, Stewartsville to Osage, Ia, 50 miles.

Projects and Surveys.

50. ***Crookston & Fort Stevenson.***—Projected, Crookston to Ft. Stevenson, No. Dak., 200 miles. President, John McLean, Crookston.

51. ***Duluth Transfer.***—Under survey, Duluth to Fond du Lac, 25 miles. President, Albert Harrington; Chief Engineer, W. B. Patton; both of Duluth.

52. ***Red Lake & Western.***—Projected, Red Lake to St. Hilaire, 40 miles. President, Frank Ives, Crookston.

53. ***Rochester & St. Paul.***—Projected, Rochester to Eden, 20 miles. A. Nelson, W. W. Mayo, both of Rochester.

54. ***St. Paul, New Ulm & Southwestern.***—Projected, Hopkins to Lakefield, 125 miles. W. C. Brenhagen, St. Paul.

Total.—Track laid in 1889, 136.1 miles. In process of construction, 175 miles. Surveyed or under survey, 75 miles. Projects of some promise, 447 miles.

NORTH DAKOTA.—Existing Roads.

47. ***Great Northern.***—Graded, Grafton to Cavalier, 32 miles.

55. ***Minneapolis, St. Paul & Sault Ste. Marie.***—Projected, Boynton to Bismark, 125 miles.

48. ***Northern Pacific.***—Jamestown & Northern R. R.—Track laid in 1889, Minnewauken to Leeds, 18 miles. Projected, Leeds to Dunsuth, 70 miles.

Total.—Track laid in 1889, 18 miles. In process of construction, 32 miles. Projects of some promise, 375 miles.

SOUTH DAKOTA.—Existing Roads.

56. ***Black Hills & Fort Pierre.***—Track laid since Jan. 1, 1890, Lead City to Piedmont, 15 miles.

57. ***Burlington & Missouri River.***—Track laid in 1889, Nebraska State line to Wyoming Territory line, 48.88 miles.

1. ***Chicago & Northwestern.***—Fremont, Elkhorn & Missouri Valley R. R.—Under construction, Whitewood to Deadwood, 10 miles. Under contract, Buffalo Gap to Hot Springs, 10 miles. Projected, Pierre to Cheyenne River, 120 miles.

18. ***Chicago, Milwaukee & St. Paul.***—Under survey, Chamberlain to Black Hills, 200 miles.

58. ***Deadwood Central.***—Under construction, Gold Run to Bald Mt., 10 miles.

59. ***Forest City & Southeastern.***—Track laid since Jan. 1, 1890, Forest City to Gettysburg, 16 miles.

47. ***Great Northern.***—Surveyed, Sioux Falls to Yankton, 60 miles.

60. ***Sioux City & Northern.***—Track laid in 1889, Minnesota State line to Garretson, 6.36 miles.

61. ***South Sioux Falls Ry. & Rapid Transit Co.***—Track laid in 1889, Sioux Falls west, 12 miles. Track laid since Jan. 1, 1890, at Sioux Falls, 1.5 miles. Under construction, 5 miles.

Projects and Surveys.

62. ***Black Hills Central.***—Located, Rapid City to Wyoming Territory line, 63.2 miles. President, Geo. Gregory Smith; Chief Engineer, Gilbert E. Bailey; both of Rapid City.

63. ***Duluth, Milbank, Huron & Chamberlain.***—Projected, Morris, Minn., to Chamberlain, 210 miles. President, D. W. Diggs, Milbank.

64. ***Duluth, Pierre & Black Hills.***—Projected, Pierre to Aberdeen, 125 miles.

65. ***Hermosa, Hill City & Western.***—Projected, Hermosa to Wyoming Territory line, 60 miles; branch to Custer City, 20 miles. President, Milton R. Masson; Chief Engineer, Alvin S. Way, both of Hermosa.

66. ***Huron & Sioux Falls Short Line.***—Projected, Walsey to Sioux Falls, 110 miles. President, A. W. Bair, Huron; Vice-President, Melville Grigsby, Sioux Falls.

67. ***Huron, Chamberlain & Black Hills.***—Surveyed, Huron to Chamberlain, 79 miles. President, D. H. Henry, Chamberlain; Chief Engineer, E. F. Harmston, Alpena.

68. ***Midland Pacific.***—Surveyed, Sioux Falls to Pierre, 221 miles. President, Samuel L. Tate; Vice-President, Jas Sampson, both of Sioux City.

69. ***Omaha & South Dakota.***—Projected, Forest City to Yankton, 225 miles. President, G. B. Hosmer; Chief Engineer, W. W. Olney, Blunt; A. N. Nason, Omaha, Neb.

Total.—Track laid in 1889, 67.24 miles. Track laid since Jan. 1, 1890, 32.5 miles. In process of construction, 35 miles. Surveyed or under survey, 623.2 miles. Projects of some promise, 835 miles.

NEBRASKA.—Existing Roads.

57. ***Burlington & Missouri River.***—Track laid in 1889. Culbertson to Beverly, 9.2 miles; Alliance to South Dakota State line, 83.04 miles. Track laid since Jan. 1, 1890, New Castle northwest, 30 miles. Under construction, end of track northwest, 145 miles. Deadwood Branch—Track laid since Jan. 1, 1890, siding No. 7 to 8 mile-post, 8 miles. Under construction, 8-mile post to Deadwood, 100 miles.

70. ***Chicago, Rock Island & Pacific.***—Under construction, Omaha to Lincoln, 54 miles.

Chicago, St. Paul, Minneapolis & Omaha.—Under survey, Randolph northwest, 20 miles.

71. ***Kansas City, Wyandotte & Northwestern.***—Track laid in 1889, Summerfield to Virginia, 20 miles.

72. ***Kearney & Black Hills.***—Under construction, Kearney to Callaway, 65 miles. President, E. C. Davidson; Chief Engineer, George Cox; both of Neligh.

73. ***Omaha Southern.***—Under construction, Union to Plattsmouth, 15 miles. W. S. Wise, A. N. Sullivan; both of Plattsmouth.

74. ***Pacific Short Line.***—Track laid since June 1, 1889, Sioux City to O'Neill, 128.5 miles. Under contract, O'Neill to Ogden, Utah, 895.5 miles. Chief Engineer, L. S. Wakefield, Sioux City, Ia.

Projects and Surveys.

75. ***Kearney, Hutchinson & Gulf.***—Projected, Red Cloud to Kearney, 65 miles. President, Geo. W. Whitaker; Chief Engineer, W. H. Elliott, Kearney.

76. ***Missouri River, North Platte & Denver.***—Projected, Albion to Arcadia, 60 miles. President, Loran Clark; Chief Engineer, J. W. Andrews; Albion.

77. ***Niobrara & Sioux Reservation.***—Surveyed, Verdigris to Niobrara, 12 miles. President, F. P. Bonnell; Chief Engineer, Sanford Horton.

78. ***Yankton, Norfolk & Southwestern.***—Located, Yankton, S. Dak., to Norfolk, 70 miles. President, Jas. H. Teller; Chief Engineer, D. C. Rice; both of Yankton.

Total.—Track laid in 1889, 112.24 miles. Track laid since Jan. 1, 1890, 166.5 miles. In process of construction, 659 miles. Surveyed or under survey, 102 miles. Projects of some promise, 125 miles.

IOWA.—Existing Roads.

79. ***Davenport, Iowa & Dakota.***—Projected, Davenport to Independence, 100 miles.

80. ***Des Moines & Northern.***—Projected, Boone to Webster City, 30 miles.

81. ***Chicago, Ft. Madison & Des Moines.***—Projected, Collett to Ottumwa, 25 miles.

60. ***Sioux City & Northern.***—Track laid in 1889, Minnesota State line south, 70 miles. Track laid since Jan. 1, 1890, end of track to Sioux City, 7.77 miles.

82 ***Tabor & Northern.***—Track laid in 1889, Tabor to Malvern, 8.79 miles.

Projects and Surveys.

83. ***Sioux City & Northeastern.***—Projected, Sioux City northwest, 38 miles. President, John Pierce, Sioux City.

Total.—Track laid in 1889, 78.79 miles. Track laid since Jan. 1, 1890, 7.77 miles. Projects of some promise, 193 miles.

MISSOURI.—Existing Roads.
(Lines within Limits of Map only.)

84. ***Chicago, St. Paul & Kansas City.***—Under construction, St. Joseph to Leavenworth, 23 miles.

Projects and Surveys.

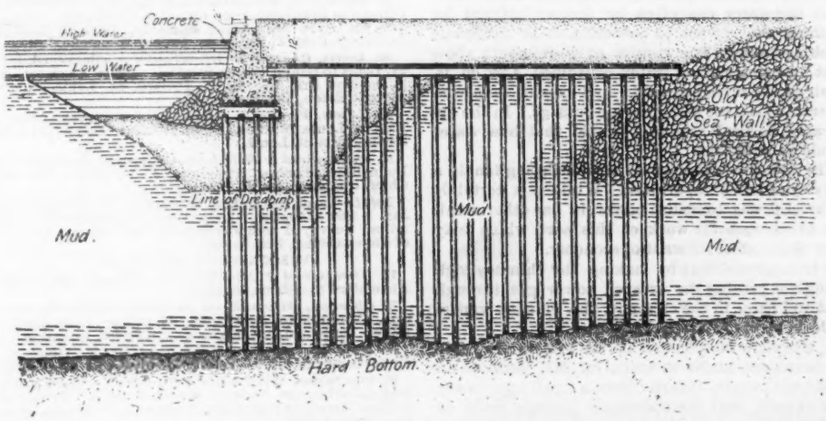
85. ***Chicago, Kansas & Nebraska.***—Surveyed, St. Joseph toward Joplin, 30 miles.

86. ***Rockport, Langdon & Northern.***—Projected, Langdon northeast, 6 miles. Secretary, John D. Doff, Rockport.

Total.—In process of construction, 23 miles. Surveyed or under survey, 30 miles. Projects of some promise, 6 miles.

Caisson Used in Founding the Sea Wall at San Fransisco.

We abstract from an article by Mr. RANDELL HUNT in the *Trans. of the Technical Society of the Pacific Coast*, the following notes on a coffer dam recently employed in San Francisco: The sea wall now being constructed there will consist of a mass of concrete 18 ft. high, 12 ft. wide at the base, and 6 ft. on top. It is founded on piles and backed by a relieving platform founded also on piles, to which the wall is anchored at intervals of 10 ft. (See cut).



SECTION OF SEA-WALL AND FOUNDATION AT SAN FRANCISCO, CAL. R. HUNT, ENGINEER.

The original harbor mud was dredged out to a depth of about 15 ft. below the base of the wall, and this trench was filled with sand before the foundation piles were driven.

The specifications required that after all the piles were in place, a subsection of the work should be coffer-dammed, the water pumped out, the piles cut off and capped, and the wall built as shown, all concrete being kept free from contact with the salt water for a week.

After some disastrous experiments the following plan was adopted and is now in successful operation.

The wall to be built is 450 ft. long and necessitates the use of 6 caissons of 70 ft. and 1 of 34 ft. in length. The water in which they are sunk varies in depth from 10 ft. at low water to 17 ft. at high water.

The caisson is made of a bottom of 2 courses of timber, of 12 ins. and 8 ins. thickness respectively, laid at right angles to one another and bolted firmly together with ¾ in. drift-bolts. The bottom timbers, the 12 in. course, are bolted together with ⅞ in. drift-bolts, long enough to pass through 3 pieces. The sides are made of 3 and 4 in. plank well spiked to the uprights which are placed 2 ft. between centers for a height of 9 ft. and 4 ft. between centers for the remaining 7 ft. These sides are fastened to the bottom by means of 1 in. iron rods, provided at the lower end with an eye or loop, connecting with iron hooks which project as shown in the cuts. These hooks are made of 1⅝ in. round iron having on their lower ends a nut and heavy washer let into the timbers so as to be flush with the botton. Partly let into the edge of the bottom plank, all around the sides and ends of the caisson, is a piece of rubber 1 in. square which makes the joint between the bottom of the caisson and its sides and ends.

The ends can be separated from the sides by withdrawing a few bolts which connect the two adjacent end posts together. A rubber strip is likewise used on the vertical seam between the ends and sides, as shown in the cut. With the exception of these joints and those between the bottom and sides, all seams are carefully caulked with oakum throughout the entire caisson.

After the bottom of a new caisson has been built and floated into position, the rods which hold the sides in place on the caisson last sunk are unhooked, and both sides and ends are lifted up by heavy tackle and swung over the new bottom. As the tide rises, the bottom is carefully guided into its proper position until it touches the sides; the rods are then quickly looped over the hooks which have been previously placed in the new bottom and screwed tight, thereby compressing the rubber strips and making a close joint.

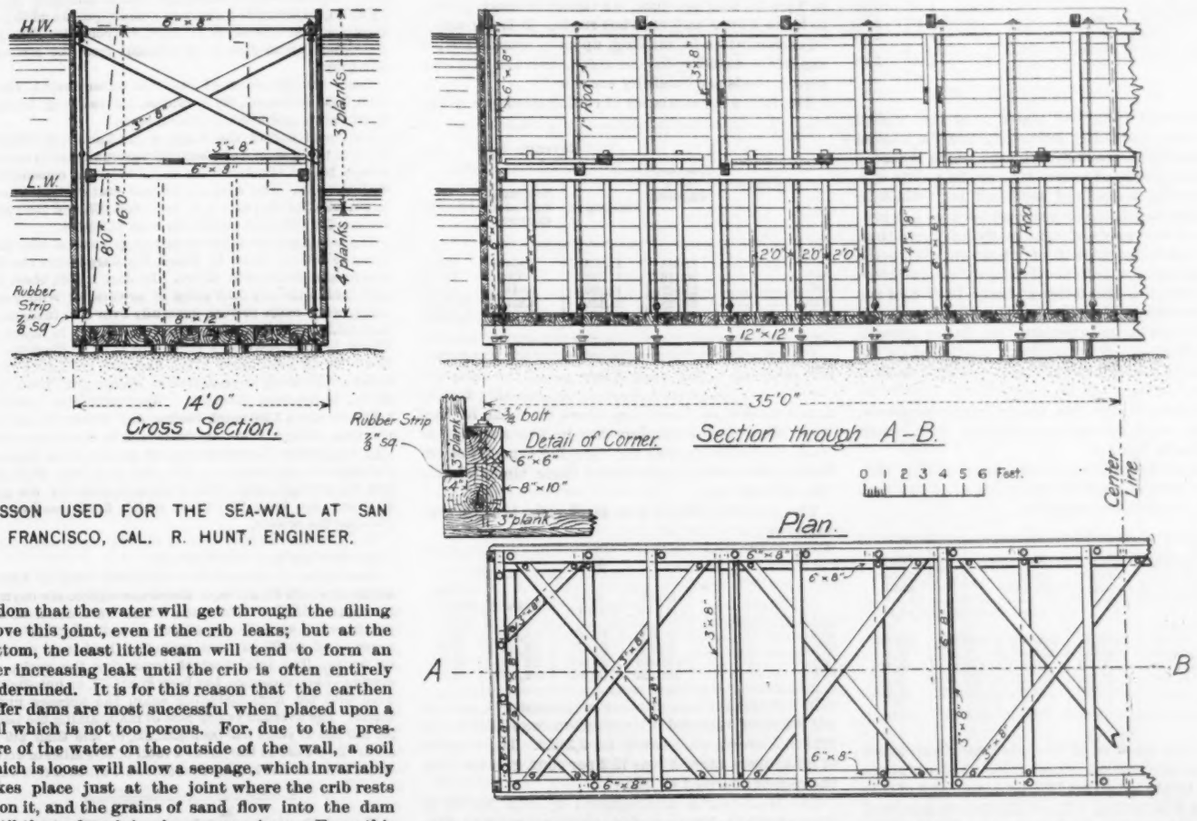
The moving of the sides of one caisson from one bottom to another is by no means the least interesting part of the work. They weigh about 30 tons, and the correct handling of them to prevent their distortion requires extreme care. The sides of the 70 ft. caissons have now been used four times, and no more leakage has been experienced with the last than the first caisson, remaining always practically nothing. The work has been very successful since this plan was adopted, no serious mishaps having occurred.

The connection between two sections of the wall after they have been sunk in place, is made by placing a coffer dam on top of the timber bottoms. The latter are made to compress a strip of rubber between them by guiding the caisson that is sinking so that it presses against the previously sunk bottom. In this way a tight joint is obtained. The sides of these coffer dams rest against another piece of rubber which is let into the edge of a timber imbedded in the concrete near the ends of each piece of wall. A projection about 2 ft. square is left at each end of

the sections so that when the latter are joined, the wall be a homogeneous from end to end.

The grillage is drift bolted to the piles of the foundation, by first locating their exact position upon the bottom of the caisson, and partly driving the bolts at these points. Pieces of gas pipe are then placed over the bolts, and the concrete deposited around them until the caisson comes to a firm bearing upon the piles; then a steel rod is let down each piece of pipe, and the bolt driven home into the pile. The pipes are afterward pulled out of the concrete and used again in the next caisson.

In other parts of Mr. HUNT's paper, of which we cannot give so complete abstracts, he states that a very good coffer dam, in depths not exceeding 4 or 5 ft., is obtained by making a cheap crib with plank sides 2 ins. thick, and with a width equal to the depth of water. In the pockets of this crib, which has been settled at the desired site, clay or some other kind of earth is placed. This filling will generally puddle itself sufficiently in the process of being put in place. In such a dam, the joint between the filling and the natural surface of the ground is the essential feature. It is



CAISSON USED FOR THE SEA-WALL AT SAN FRANCISCO, CAL. R. HUNT, ENGINEER.

seldom that the water will get through the filling above this joint, even if the crib leaks; but at the bottom, the least little seam will tend to form an ever increasing leak until the crib is often entirely undermined. It is for this reason that the earthen coffer dams are most successful when placed upon a soil which is not too porous. For, due to the pressure of the water on the outside of the wall, a soil which is loose will allow a seepage, which invariably takes place just at the joint where the crib rests upon it, and the grains of sand flow into the dam until the undermining becomes serious. From this fact, some engineers prefer a filling of gravel and clay, for, if any material is drawn from under the crib, the gravel will fall and fill the space. Mr. HUNT, however, prefers to use a more compact material in small dams; one which will cement itself closely to the ground in the first place, and which will not permit the leakage of coarse gravel.

If the soil is a light, porous one, on which the dam is to be built, either as an unprotected embankment or as a crib, the base should be as broad as circumstances will permit or an entirely different kind of coffer dam should be used. An earthen dam, without the protection of the crib described above, will need slopes of about 1.5 or two horizontal to 1 vertical, on both outer and inner sides. For a dam 4 ft. high, with a width above of at least 4 ft., the base will be from 16 to 20 ft. wide. Where the current is swift, rows of gunny bags filled with sand should be placed along the toe of the embankment or the foot of the crib.

In sheet-pile coffer dams, it is wrong to drive sheet-piling between upright posts or piles placed at certain intervals, although this method is one of the old standard ones mentioned by engineering authors. The use of these posts is not apparent, for sheet-piling, if properly shaped and driven, will make a close fit and not require the posts to aid in wedging. If it is necessary to give lateral support to the sides of a dam by using large posts it is far better to place them on the inside where they will not interfere with the piling. It is well to have a waling piece on the outside of the sheet-piles at their tops and drive them between this and the inside waling piece. The frame-work of these pieces should be carefully put in position before the driving begins.

Railways of the United States in 1889.

The advance sheets of the forthcoming annual issue of "Poor's Manual," just received, show that, notwithstanding floods, rate wars, strikes and other troubles, the year 1889 was, on the whole, a prosperous one for the railways of the country.

The total extent of the railways of the United States, on Dec. 31, 1889, as given by the "Manual," is 161,396 miles. Of this 852 miles were completed since the close of the fiscal years of the companies.

Earnings.—Passengers	$259,740,807
Freight	666,530,653
Other	66,865,396
Total	$992,856,856
Operating expenses	674,731,517
Net earnings	$318,125,339
Other receipts, including rentals received by lessor companies	88,804,148
Total available revenue	$406,929,487
Passengers carried	495,124,767
Passengers—mileage	11,965,726,015
Tons moved	619,137,237
Tons one mile	68,604,012,396
Payments from available revenue:	
Interest on bonds	$211,171,279
Other interest	6,747,142
Dividends	79,532,863
Rental	44,798,129
Miscellaneous	34,153,554
Total	$376,402,967
Balance—excess of available revenue over actual payments therefrom for the year.	$30,526,520

The magnitude of the railway interest can only be realized by comparing some of the above enormous figures with other values. As stated in the first table, the total assets of the United States railways are now over ten billions of dollars. Of course this is counting all securities at par value. But that the railways of the United States are actually worth even more than this vast sum to their owners is seen by the fact that the total net earnings for the year amounted to over 406 million dollars, or enough to pay almost 4% on the above stated assets. Investments which pay a sure dividend of 4% are in steady demand at a premium. Hence our statement that the railways of the country are worth over ten billion dollars, stands proved.

In another part of the Manual is a table of the assessed valuation (for purpose of taxation) of all the States of the Union, from which it appears that the total valuation of all the taxable property in the United States is a little over 21½ billion dollars. It will not do to argue from this, however, that railway investments form nearly half the national wealth; for the valuation for taxation is always far below the real value, and a great proportion of the wealth of the country wholly escapes taxation. In 1880 the total wealth of the United States was estimated at about 47½ billion dollars, of which railways formed about 6 billion dollars. If other wealth has increased in the same ratio as railways in the past

The capitalization of the remaining 160,544 miles is as follows:

Liabilities.	
Capital stock	$4,495,099,318
Funded debt	4,828,365,771
Unfunded debt	357,477,160
Current debt	250,510,897
Total liabilities	$9,931,453,146
" " per mile	60,309
Assets.	
Cost railroad and equipment	$8,508,081,477
Real estate, stocks, bonds and other investments	1,177,431,927
Cash, bills receivable, current accounts, etc., etc	429,979,646
Total assets	$10,205,493,050

The capital stock per mile has decreased $769, and the bonded debt per mile has increased $106 from the figures for the preceding year. This is because the new mileage is capitalized very low compared with the old.

The results of operations for the year were as follows, on a total mileage reporting of 152,689 miles:

Passenger train mileage	279,620,145
Freight train mileage	430,719,737
Mixed train mileage	13,432,260
Total Train Mileage	723,772,142

ten years (which is hardly probable) the total wealth of the United States is now about 80 billion dollars.

In the following table various figures per mile are given for 1889, 1888 and 1884:

	1889	1888	1884
Per mile of completed road:			
Stock	$27,999	$28,768	$30,064
Bonded debt	38,078	29,972	29.317
"Cost of road and equipment"	53,536	54,008	55,329
Per mile of road in operation:			
Passenger earnings	1,771	1,729	1,801
Freight earnings	4,365	4,397	4,382
Gross earnings	6,574	6,540	6,663
Net traffic earnings	2,117	2,045	2,318
P. C. expenses to earnings	67.90	68.72	65.21
Pertrain mile:			
Pass. earnings per pass. t. m.	$0 928	$0.937	$1.001
Frt. earnings per frt. t. m.	1.547	1.557	1.502
Gross earnings per revenue t. m.	1.372	1.380	1.410
Gross expenses per rev. t. m.	0.933	0 948	0.918
Net earnings per rev. t. m.	0.439	0.432	0.492
Proportion of gross:	%	%	%
Passenger earnings	26.95	26.44	27.1
Freight earnings	66 40	6. 24	65.9
Other earnings	6.65	6.32	7.0
	Cents.	Cents.	Cents.
Earnings per pass. mile	2.170	2.246	2.356
Earnings per ton mile	0.976	0.977	1.124
	Miles.	Miles.	Miles.
Ave. distance per pass.	24.17	24.78	26.24
Ave. haul per ton	110.80	110.72	112.07
	%	%	%
Interest % of bonds	4.38	4 35	4.66
Interest % of bonds and debt	4.20	4.17	4.51
Dividends % of stock	1.77	1 77	2.48
Int. and div'ds % of stock, bonds and debt	3.07	3.03	3.52

It will be seen from the above that the capital stock per mile is steadily decreasing and the bonded debt is steadily increasing, a change which is hardly in the interest of good railroading or the public welfare. Earnings per mile of road and per train mile show a slight tendency to decrease because the construction of new roads of light traffic has more than kept pace with the growth of traffic on old roads. Freight earnings remain pretty steady at two-thirds the total receipts. Both the average haul and the average passenger journey seem to be decreasing in length. The latter is perhaps due to the growth of elevated railway and suburban traffic, while the shortening of the freight haul may possibly be due to the development of local traffic by Interstate Commerce law, though this seems hardly probable. The interest on bonds and the dividend rate is seen to be gradually falling.

A very interesting table for the years 1876 to 1889, giving the mileage, capitalization, earnings and payments, we condense as follows:

	Length of line operated	Gross traffic earnings	Net traffic earnings	Interest paid.	Dividends paid.
	M.	(In thousands of dollars.)			
1875	73,508	$497,257	$186,452	$93,559	$68,039
1880	82,146	613,733	255,557	107,866	77,115
1884	115,704	777,396	270,890	178,058	94,414
1888	145,387	960,256	301,631	207,124	80,243
1889	152,745	1,003,736	322,284	219,877	81,264

The striking features of this table are that gross earnings have doubled since 1876. Net earnings have only increased about 73%, however, and of this increase of $136,000,000, all but $13,000,000 has been used for the payment of interest on bonds. In 1876 fixed charges were a little over 1¼ times the dividends. In 1889 they are over 2⅝ times the dividend payments.

The average freight train load has marvellously increased from 129 tons in 1880 to 143 tons in 1885 and 157 tons in 1889. The number of passengers per passenger train remains about the same, however, although it is probable that the weight of the average passenger train is steadily increasing because of the stronger and heavier cars and more luxurious accommodations now in use for passenger traffic.

In a table giving population and area per mile of railroad for each State. Rhode Island is seen to have the greatest number of inhabitants per mile of railroad, 1,432. Arizona is at the end of the list with only 45 inhabitants per mile of railroad. Evidently Arizona railways do not live on their local passenger traffic. Nevada has only 66 inhabitants per mile of railway; but she has 120 sq. miles of territory (such as it is) for each mile of railway to draw from. New Jersey has but 3.84 sq. miles per mile of railway, and here, too, as is well known, the local traffic is comparatively unimportant.

The total extent of the railways of the world in 1888 is given as 571,771 kilometers or 355,134 miles divided among the continents as follows:

	Kilometers.	Miles.
America	304,005	188,823
Europe	214,252	133,075
Asia	28,415	17,648
Australia	16,790	10,428
Africa	8,309	5,160
Total	571,771	355,134

The statistics of railway construction show a total for 1889 of 5,751 miles. Our own records for 1889 now show a total of 5,043 miles, or 708 miles less. As the Manual does not contain a list of the roads on which this mileage was laid we are unable to tell certainly how the discrepancy arises; but from the fact that on comparing our records by States the difference seems to be principally in lumbering and mining States, we are led to believe that a very considerable mileage of logging or mining branches, or road used for temporary traffic, must be included in the Manual's statistics. For example, our records show but 200 miles new construction in Michigan, whereas the Manual shows 344. In Wisconsin and Minnesota the Manual shows 72 miles more than our own records. In New Mexico the Manual shows 171 miles. Our records show no construction in that Territory in 1889, and if 171 miles of railroad were built in New Mexico last year, we should be much pleased to learn where and on what roads. It is our aim to be conservative in making up our records and, as explicitly stated upon our maps, private and temporary roads are carefully excluded.

The following statistics of rolling stock are given:

Year.	Locomotive engines.	Revenue cars.		
		Passenger.	Baggage, mail and express.	Freight.
1877	15,911	12,053	3,854	392,175
1881	20,116	14,548	4,976	648,295
1885	25,937	17,290	6,044	805,519
1888	29,398	21,425	6,827	1,005,116
1889	31,062	23,465	7,184	1,060,164

It thus appears that while rolling stock has generally doubled in the past dozen years, the delays in handling freight cars have made it necessary to very much more than double our stock of them in that line. Considering the increase in the average car load, it is probable that the carrying capacity of our freight car rolling stock is now three times what it was 12 years ago.

The growth in the use of steel rails is shown as follows:

Year.	Miles.			P. c. steel of total.
	Steel rails.	Iron rails.	Total.	
1880	33,680	81,967	115,647	29.1
1884	90,243	66,254	156,497	57.6
1888	138,516	52,981	191,497	72.3
1889	151,723	51,064	202,787	74.8

In 1882 the average number of passengers carried per mile of railroad in operation was 3,018.5. In 1889 this average increased to 3,242.6. The number of passengers carried was 71.2 per cent. greater than the number carried in 1882.

The MANUAL is accompanied by map No. 22 of ENGINEERING NEWS series, showing railway construction in the United States for four consecutive years, with explanatory text.

The Public Works of Philadelphia.

The present extent of the public works of the city of Philadelphia is very concisely set forth in an appendix to the third annual message of Mayor FITLER; the facts there given being in response to a request from the Census Bureau for information to be incorporated in the Eleventh Census report. We abstract below some of the most interesting data:

There are within the city limits, 1,151.6 miles of streets and alleys, and of these 749.8 miles are paved as follows:

	Miles.		Miles.
Stone, cobble	392.2	Macadamized	96.
" block	98.2	Asphalt, sheets	15.6
" artificial	.5	" blocks	18.3
Brick	11.2	Rubble	117.6
		Total	749.8

Of the unpaved streets, about 50 miles are graded and curbed. The average width of the streets, between building lines is 50 ft.; the widest streets 144, and the narrowest 10 ft.

Of the 1,416 miles of sidewalks, 1,250 miles are paved with brick, 10 with brick and stone, 100 with stone alone, 1 with asphalt, and 5 with wood. The material used for the remaining 50 miles is not stated.

The average yearly cost for the past 10 years of all street work, exclusive of cleaning, has been $637,550, of which $364,632 has been expended for construction, and $272,918 for repairs. The average yearly cost of street cleaning for the same period has been $283,979.

The total number of street lamps in the city is 26,043, of which 50 electric lamps are private. There are 18,470 gas lamps, all but 380 of which are maintained by the city at an annual cost of $22.50 each. The 380 lamps are maintained by the Northern Liberties Gas Co. at a contract price of $22.27 per lamp per annum. There are 1,095 electric lamps, all but 50 of which are maintained by seven different companies at a yearly price of $18.50. The remaining street lamps, 6,478, burn naphtha, gasoline, etc., and are maintained by the Pennsylvania Globe Gas Light Co. at $21 each per year. All the lamps burn all and every night throughout the year.

The water-works, as well as the gas works, are owned and operated by the city. Ninety per cent. of the supply is taken from the Schuylkill, and 10 per cent. from the Delaware River. All the water is pumped, either to reservoirs, stand-pipes, or directly to the distributing pipes. The pumps have a combined daily capacity of 185,290,000 galls., and the average daily consumption is 116,500,000 galls. There are nine reservoirs with a combined capacity of 891,491,454 galls; also two stand-pipes, 5 and 30 ft. in diameter, and 153 and 90 ft. high, respectively. The first mentioned stand-pipe is of wrought iron, the second of cast iron.

There are 930 miles of cast iron water mains, 170,911 taps, 7,433 hydrants, 646 fountains, 343 watering troughs, 12,246 valves and but 304 water meters.

The total cost of the works is not known, as different parts of the system were built by various districts or companies before the localities supplied were consolidated with the city. The average annual cost of maintaining the works for 10 years has been $545,067, and the yearly income for the same period has been $1,688,508.

The combined sewerage system is in general use, there being 80 outlets, most of which discharge into the Delaware and Schuylkill rivers. To Jan. 1, 1890, there had been laid in the city 367.9 miles of sewers, of which 66.59 miles were main sewers generally over 3 ft. in diameter and 301.31 miles branch sewers 3 ft. and less in diameter. Of the branch sewers 18 miles are 12 in. in diameter, or thereabouts, two miles 8 in., and the remaining 281.31 miles are all brick sewers, mostly egg-shaped, from 3 to 3½ ft. in vertical diameter. Approximately, there are 8,000 manholes, 7,200 catch-basins, and 100,000 house connections. There is but one flush tank in the whole city. The total cost of construction of sewers from the consolidation in 1855 to Jan. 1, 1890, has has been $8,056,435, and the average yearly cost of maintenance for the past 10 years has been $25,000, of which $4,000 has been for cleaning the sewers.

The average annual cost of the fire department for 10 years past has been about $625,000.

The city has 11 parks with a combined area of 2,884.52 acres, of which 373 acres, or about one-eighth, are covered by water. All but 177.3 acres, which were donated, was purchased by the city at a total cost of $17,503,522 or an average of $6.466 an acre, including land now covered by water. The total cost of improving the parks, exclusive of maintenance, has been $1,823,671, or but slightly over $700 per acre, including again the acreage under water. The average yearly cost of maintaining the parks for the last 10 years has been $260,100, or less than $10 an acre. There are in the parks a total of 32½ miles of driveways, 7.82 miles of bridleways, and 40.77 miles of footways

Legal Decisions of Interest to Engineers.

Change in Contract.—Where a board of county commissioners appointed a superintendent to supervise the erection of a public building, and he makes changes in the contract which add to the expense, and the commissioners accept the work, they are liable for the added expense as if the changes in the contract had been in writing, on the ground that the superintendent has power to bind the county for work beyond the written contract. (Gibson County v. Motherwell Iron & Steel Co. Supreme Court of Indiana, 24 N. E. Rep. 315.)

Liability of Municipality for Injuries Received from Falling into Excavations in its Street.—A municipality is liable to persons for injuries arising from neglect to keep proper lights and guards around a ditch or excavation which it has caused to be made in the streets, and such liability cannot be avoided by contract. (McAllister v. City of Albany, Supreme Court of Oregon, 23 Pac. Rep., 845.

Liability of Railway Company for Board of its Employés.—It is not incident to the operation of a railroad that it should pay the board of its employés, and a road-master cannot bind his company for board of hands, without express authority to do so. (St. Louis I. M. & S. Ry. v. Bennet, Supreme Court of Arkansas, 13 S. W. Rep., 742.)

Gates at Railway Crossings.—A man was injured while crossing the tracks of defendant railway. The tracks were guarded by gates, one of which was raised so that he could go on the track. The raising of the gates was an assurance of safety just as significant as an invitation would have been, and one that the plaintiff was fully justified in accepting, and the company is liable. (Kane v. New York, N. H. & H. Ry. Co., Supreme Court of New York, 9 N. Y. Supp., 879).

The New Railway Terminals at Providence R. I.

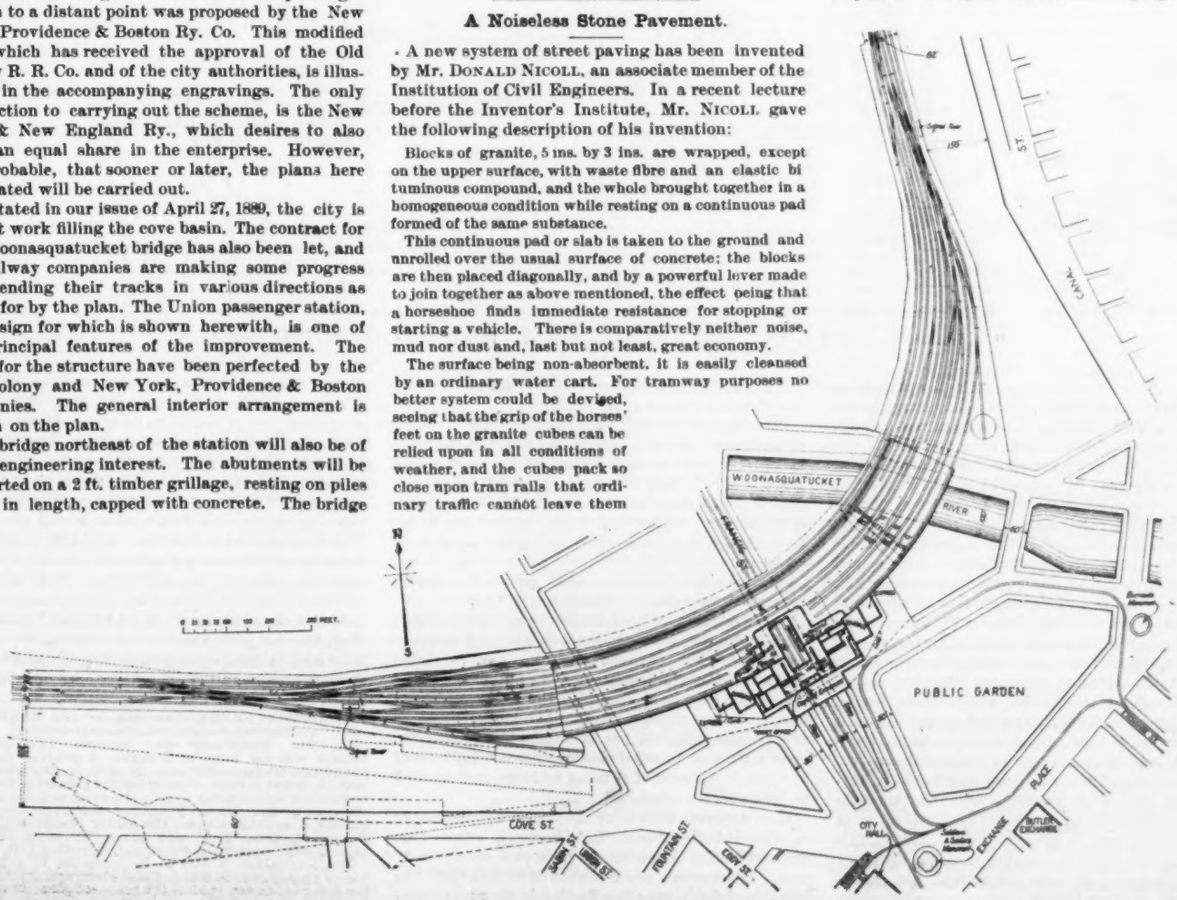
In our issue of April 27, 1889, we published the plans for improved railway terminals at Providence, R. I., proposed by a board of experts consisting of Messrs. Jos. M. WILSON, DON. J. WHITTEMORE and ALFRED P. BOLLER. These plans, however, did not meet with approval by the railway companies interested, and in June, 1889, a modification of the experts' plan giving more room in the station and yards and avoiding the removal of the passenger station to a distant point was proposed by the New York, Providence & Boston Ry. Co. This modified plan, which has received the approval of the Old Colony R. R. Co. and of the city authorities, is illustrated in the accompanying engravings. The only obstruction to carrying out the scheme, is the New York & New England Ry., which desires to also have an equal share in the enterprise. However, it is probable, that sooner or later, the plans here illustrated will be carried out.

As stated in our issue of April 27, 1889, the city is now at work filling the cove basin. The contract for the Woonasquatucket bridge has also been let, and the railway companies are making some progress in extending their tracks in various directions as called for by the plan. The Union passenger station, the design for which is shown herewith, is one of the principal features of the improvement. The plans for the structure have been perfected by the Old Colony and New York, Providence & Boston companies. The general interior arrangement is shown on the plan.

The bridge northeast of the station will also be of much engineering interest. The abutments will be supported on a 2 ft. timber grillage, resting on piles 45 ft. in length, capped with concrete. The bridge will require about 4,000 cu. yds. of masonry. Another bridge, with a 260 ft. draw span, will be built at Fox Point by the New York, Providence & Boston Co., and the same corporation will eliminate many grade crossings by the construction of an elevated viaduct about one mile in length.

In connection with this a double belt railway is proposed, one loop being devoted principally to passenger traffic, and the other to freight transfers. The former will be 7.86 miles in length, 6.55 miles of which are already finished.

PROPOSED UNION RAILWAY STATION AT PROVIDENCE, R. I. S. L. MINOT AND E. P. DAWLEY, ENGINEERS.



PLAN OF IMPROVED RAILWAY TERMINAL FACILITIES AT PROVIDENCE, R. I.

A Noiseless Stone Pavement.

A new system of street paving has been invented by Mr. DONALD NICOLL, an associate member of the Institution of Civil Engineers. In a recent lecture before the Inventor's Institute, Mr. NICOLL gave the following description of his invention:

Blocks of granite, 5 ins. by 3 ins. are wrapped, except on the upper surface, with waste fibre and an elastic bituminous compound, and the whole brought together in a homogeneous condition while resting on a continuous pad formed of the same substance.

This continuous pad or slab is taken to the ground and unrolled over the usual surface of concrete; the blocks are then placed diagonally, and by a powerful lever made to join together as above mentioned, the effect being that a horseshoe finds immediate resistance for stopping or starting a vehicle. There is comparatively neither noise, mud nor dust and, last but not least, great economy.

The surface being non-absorbent, it is easily cleansed by an ordinary water cart. For tramway purposes no better system could be devised, seeing that the grip of the horses' feet on the granite cubes can be relied upon in all conditions of weather, and the cubes pack so close upon tram rails that ordinary traffic cannot leave them exposed. Gas and water mains may be got at readily and the same cubes or blocks relaid at small cost.

Considerable discussion on the part of engineers and others present then ensued, and the lecturer explained that waste fibrous substances incorporated with bitumen were comparatively imperishable, as shown by Egyptian mummy wrappings and that this preparation (a cheap product) was not brittle, but was almost as elastic as indiarubber; it did not ooze from the joints, the fibre incorporated with it acting like the caulking used in forming a ship's deck. The pliant substance keeping the gran

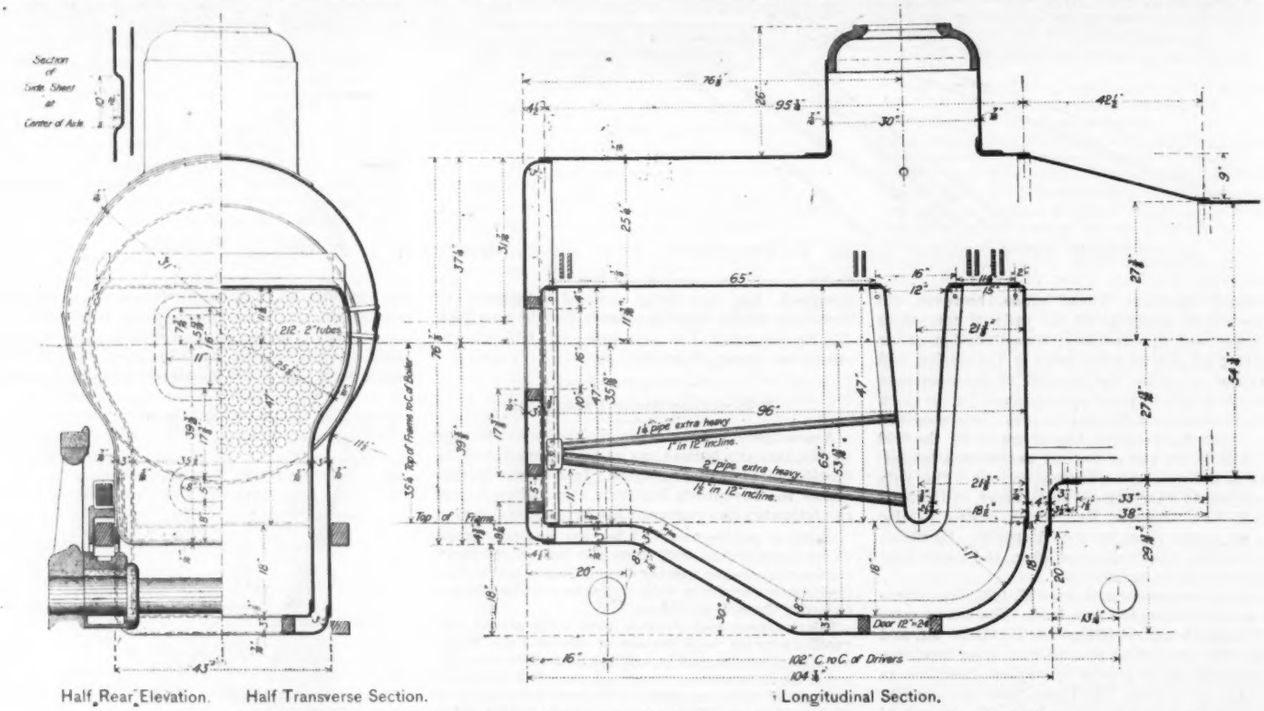
ite blocks half an inch apart, and slightly yielding on percussion, a horseshoe has always a hold upon the granite.

Where no great traffic exists, the noise-destroying pad placed between the blocks may, as at Leicester, be dispensed with. However, taxpayers who object to noise, or wear and tear upon their carriages, would, it is believed, not object to pay for the small additional cost of the bitumen elastic pad shown by the model.

A "Downward Draft" Locomotive.

The accompanying engraving shows the fire box of a novel locomotive recently completed at the Portland Locomotive Works for the Complete Combustion Co., of Boston, Mass. The locomotive has been put in service on the Portland & Ogdensburg division of the Maine Central R. R., making its first trip on July 24.

A downward draft stationary boiler, built under the patents of the Complete Combustion Co., was illustrated and described in ENGINEERING NEWS of Sept. 7, 1889, and, as may be seen by reference to that engraving, the locomotive boiler here shown is very similar in type to the stationary boiler there described. The stationary boiler averaged in two trials an evaporation of 12.12 lbs. of water per lb. of combustible from and at 212°.



Half Rear Elevation. Half Transverse Section. Longitudinal Section.

"DOWNWARD DRAFT" FIRE BOX FOR LOCOMOTIVE, PORTLAND LOCOMOTIVE WORKS.

The mode of operation of the downward draft boiler is easily seen by reference to the engraving. The upper row of tubes forms a water grate, sloping toward the door. The tubes which form the grate are attached in front to the water leg and at the rear to a gun-metal box, which is supported by the back of the fire box, but is not rigidly connected to it. The burning coal lies on the upper row of tubes, and the air passes down through the fuel, between the row of 2-in. tubes to the combustion chamber, thence it curves up around the water leg to the tube sheet. The inclination given to the water tubes keeps up a rapid and regular circulation within them; and as they are joined to the water leg and are not fastened to the rear end of the fire box, there can be no strain upon their fastenings due to expansion or contraction. Air for the fire is admitted through the furnace door, and when running with the throttle closed, or when steam is made faster than it is needed, the air can be shut off from the fire much more perfectly than is possible with the ordinary ash pan dampers. In case not enough air passes through the burning fuel to produce complete combustion, air is admitted to the combustion chamber through the lower door shown in the engraving. The ashes from the fire fall down on the inclined fire box bottom, which is made double with a water space between, and are removed at the central door.

The locomotive to which this novel fire box has been applied is an American type passenger locomotive with 6 8-in. drivers, and a total wheel base of 22 ft. 11 ins. It has a wagon top boiler with the steam dome set directly over the water leg of the fire box, as shown in the engraving. If this construction does not cause foaming, it will be a very remarkable occurrence, unless, indeed, the designer has put a baffle plate between the water leg and the steam dome, which does not appear in the drawing. The water leg, it is to be remembered, is quite narrow, and very close to the fire, and it receives all the steam made in the two rows of tubes, which are in the hottest part of the furnace. However well this arrangement may work with the mild draft of a chimney, it seems probable that in the intense combustion due to the forced draft of a locomotive there will be little solid water in the lower part of the water leg, and there will be danger of burning out the tubes of the grate. It will probably be found necessary to add some circulating pipes, taking water from the barrel of the boiler and delivering it at the bottom of the water leg.

With the fire so near the door the fire box should be comparatively easy to feed and manage, although it might require more bending of the back than a grate in the bottom of the box. Whether the ash door can be opened to clean the fire when the engine is running we are not informed, but we hardly see how it could be without drawing a great quantity of ashes and cinder into the tubes. But unless it can be opened while running, there might be a pretty large accumulation of ashes on a long run.

The designers of this locomotive expect her to burn fuel more economically than can be done in the common fire box, to make no smoke, and to throw no sparks or cinders whatever. In pursuance of the latter idea they have discarded the extension front end, and use a plain, straight, open stack. Press reports state that "on her trial trip the locomotive drew a train of 4 loaded passenger cars a distance of 38 miles at the rate of 40 miles an hour, and emitted no black smoke or cinders."

More accurate records of the engine's performance as regards both economy and thorough combustion without smoke or sparks are promised at an early date. There seems much reason to believe that the downward draft may be effective in procuring freedom from sparks at least.

The Diamond Shoals Lighthouse.

We are unable to give until next week the conclusion of the drawings accompanying the three leading bids for this lighthouse, which we gave in part last week. In the meantime, we give the following interesting discussion of the stability of the lighthouse, designed by Mr. THEODORE COOPER, and illustrated last week.

Our attention has also been called to the fact that in speaking of the terms of the bids last week we did an injustice in not recognizing the fact that all the bids were alike in asking no payments until all the dubious parts of the work were over, *i. e.*, until the caisson was securely sunk in the sand against all chance of disturbance by storm. We have not had the advantage of seeing the bids, and understood that their terms were somewhat different from what they are now explained to us to be. It will be generally admitted that if the bids are so nearly alike in their terms as this, so that the government is not asked to assume a risk under any of them, the best plan should win, and not merely the longest purse; for to insist on a contractor carrying the financial burden beyond the point where there is real risk would be a hardship and an injustice. We are not saying at what point such risk ceases; we do not yet attempt to form an opinion; it may be as soon as the caisson is anchored, or it may not be for years after it is sunk; but we do say that the government has no need and no moral right to force a contractor to loan it money as a condition for considering his bid, and that is what it will amount to if he is compelled to wait for estimates beyond the point where there is a reasonable chance that the waves may destroy the work done. It is, of course, extremely hard to say at what point of construction risk of destruction ceases in an exposed locality like that, but the government engineers ought certainly to be able to form a fairly approximate opinion, and that opinion, whatever it may be, we are not disposed to question.

INVESTIGATION OF THE STABILITY OF THE LIGHT-HOUSE UNDER THE FORCES TENDING TO DESTROY.

1st. *The foundation and subbase.*—The proposed caisson will not have a draught of over 13 ft. when towed into its final position. It will be desirable from both the point of view of securing the caisson as promptly as possible by entering it into the sand, and the point of view of greater security against storms and scour, to ground the caisson upon the higher shoals within the prescribed area. It is very likely, therefore, that the caisson will be placed in water not exceeding 15 ft. depth.

The foundation is also to be protected by a bank of heavy rip-rap, which will prevent scour and act to break the force of the sea against the proposed structure. That it will so act is a fair assumption, as experience with break-waters on exposed coasts shows that the heavy

seas do not affect such rip-rap to any extent at depths varying from 10 to 15 ft. below the sea level.

For the purpose of showing, however, the absolute security of our proposed structure, we will examine its stability under the worst possible assumptions. Then if we find it secure we can have no reasonable doubt of its perfect security under the actual conditions of its proposed construction.

We will therefore assume that the monolith stands in 24 ft. of water, unprotected by rip rap, and that the caisson is entered into the sand 50 feet as a probable maximum depth of foundation.

We will assume that the lighthouse is at the same time acted upon by a wind force exceeding the highest that has been measured, and rollers as great as can occur in this depth of water, far exceeding those to be expected at this point, and both acting at the same time and in the same direction—another improbability.

(a) *Pressure on base from superincumbent weight.*

Weight of caisson, wood and iron	718,000 lbs.
" " concrete in caisson chambers	955,000 "
" " monolith 64 ft. high and 40 ft. in diameter	11,733,000 "
Total weight of material below low water.	13,406,000 lbs.
Buoyancy due to water displacement	6,518,000 "
Downward pressure of material below low water	6,888,000 "
Monolithic cone, 11 ft. 6 ins. high (40 and 32 ft. diam.)	1,746,500 "
Monolithic cylinder, 20 ft. high (32 ft. diam.)	1,885,500 "
Coal, water, etc., in vaults	125,000 "
Total weight of subbase, less buoyancy	10,645,000 lbs.
Weight of shell of light-tower, iron and brick	700,000 "
Weight of floors and load at 75 lbs. per sq. ft.	345,000 "
Total load of base	11,690,000 lbs.
Area of base of caisson, 2,133 sq. ft.	
Pressure per sq. ft. of base	5,480 lbs., 2.45 tons.
Load above caisson	11,017,000 "
Area of base of monolith	1,256.6 sq. ft.
Pressure per sq. ft. on timber of caisson	8,767 lbs., 3.91 tons.

(b) *Effects of wind and waves.*

We will assume a pressure of 50 lbs. per sq. ft. acting upon the projected area of the light-house. RANKINE states that a wind force of 100 lbs. per sq. ft. will only give an effective wind pressure of 50 lbs. on the projected area of a round tower. BAKER, in the Forth Bridge, found that the recorded pressure per square foot on a gauge of 300 sq. ft. of area only equalled two-thirds of the pressure measured at the same time on a gauge having 1½ sq. ft. of area. Our assumed pressure of 50 lbs. over the whole exposed surface of the tower would be equivalent then *to 150 lbs. on a small anemometer gauge.*

Surface of iron tower exposed	3,036 sq. ft
Wind force against iron tower	151,800 lbs.
Center of pressure of this force	86 ft. above H. W.
Surface of base exposed to wind	640 sq. ft.
Wind force against this base	32,000 lbs.
Center of pressure of this force	20 ft. above H. W.

For the wave force striking the base of the tower, we will assume that due to rollers 24 ft. high. The maximum pressure exerted by such a roller against a vertical wall reflecting the whole wave would be 3,090 lbs. per sq. ft. The average pressure over the whole surface struck would, however, be only half of this, or 1,545 lbs. per sq. ft.

The pressure, however, which could be exerted by such a wave against an isolated cylindrical structure would not be over ¼ of that exerted against a continuous wall. This may be accounted for in the following manner: First, the effective resisting surface of a cylindrical body against a moving fluid of constant dynamic head is only one-half that of a plane surface. Second, the dynamic head of a wave striking a cylindrical body would vary at all points of the curve in proporton to the amount of reflection.

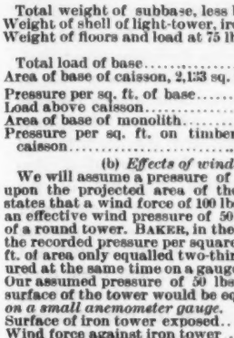


FIG. 1.

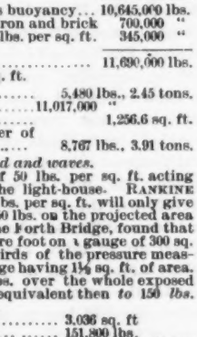


FIG. 2.

At point *c* the reflection would be perfect and theoretically for this element the pressure would be that of a continuous wall, but at *a* and *b* the reflection would be nothing. We can conceive that the curve, Fig. 2, represents the relative reflection, or the dynamic heads due to the reflection. The average dynamic head would then be about ⅔ that due to a continuous wall. The effective area being ½, and effective dynamic head ⅔, the total effect would only be ⅓ of that of a wave striking a continuous vertical wall.

The average pressure, therefore, over surface struck by such a wave would be 515 lbs

Surface of base exposed to wave action, 700 sq. ft.
Wave force against base, 391,400 lbs.
Center of pressure not above H. W.
Total wave and wind forces, 575,200 lbs.

Before determining the effects of these forces upon our subbase, it will be necessary to determine the point of maximum moments. For this purpose, we will assume that the overturning moments of the wind and waves are entirely resisted by the moments of the sand pressure.

By RANKINE, the passive resistance of the sand would be

$$P = \frac{Wx^2}{2} \times \frac{1+\sin y}{1-\sin y} \times 40 \text{ ft.}$$

where
w = weight of sand, assumed as 50 lbs., less buoyancy.
x = depth of sand in feet.
y = angle of slope, assumed as 1 to 1½ = 33° 42'.
Then $P = 3{,}440\ X^2$.

From the well known principle that the maximum moment occurs at point of "no shear" or where the sand force neutralizes the wind and wave forces, we make the equation:

$3{,}440\ X^2 = 575{,}200$, from which we get $X = 14$ ft.

Or, the maximum moments of the wind and wave occur 14 ft. below the level of the sand; or in other words, the passive action of 14 ft. of sand is equivalent to the pressures due to the wind and waves, and at this point we may consider our monolith fixed.

Taking the moments about this point, or 38 ft. below high water, we get

wind,	151,800 lbs.	× 124 ft.	= 18,823,200 lbs. ft.	
"	32,000 "	× 58 "	= 1,856,000 " "	
waves,	391,400 "	× 38 "	= 14,873,200 " "	
Maximum moment			= 35,552,400 " "	

This moment must equal the moment of resistance of the monolith.

Moment of resistance of monolith $= R\frac{I}{S}$ where R = the strain per square foot at the extreme edge, and which will be + or compression on side opposite to the wind and wave forces, and − or tension on the other side.

I = moment of inertia in feet of the monolith.

S = distance in feet from center to extreme edge = radius = 20 ft.

$$\frac{I}{S} = \frac{\pi r^3}{4} = 6{,}285$$

$$R = M \div \frac{I}{S} = \frac{35{,}552{,}400}{6{,}285} = \pm 5{,}656 \text{ lbs. per sq. ft., or the}$$

wind and wave forces induce a force of 5,656 lbs. compression on one side and 5,656 lbs. tension on the other.

To get the actual strain at this point, however, we must combine these induced strains with the compression due to the load above this point, which is 6,690 lbs.

Combining these we get on
one side, + 6,690 + 5,656 = + 12,346 lbs. compression,
other side, + 6,690 − 5,656 = + 1,034 " "

From which we see that the wind and wave forces do not produce tension at this point and only produce a maximum compression of 12,346 lbs. per sq. ft. or 86 lbs. per sq. in. on the concrete.

This is upon the supposition that all the strain is taken up by the concrete alone. If, on the other hand, we should assume the bending moments to be taken up entirely by the iron shell we would get $\frac{I}{S}$ for iron shell = 67,800 in inches.

Moment = 35,552,400 × 12 in inches.

$\frac{35{,}555{,}400 \times 12}{67{,}800} = 6{,}292$ lbs. per sq. in. on iron shell, a perfectly safe strain.

The above investigation is made for a depth of water of 24 ft. below high water. For any other depth of water we can get the results in the following manner:

For a change of each foot above or below 24 ft. depth of water the moments of the wind and wave forces will be decreased or increase as follows:

Total forces, 575,200 lbs. × 1 = 575,200 ft. lbs. which divided by $\frac{I}{S} = 6{,}285$, gives an additional value to R equal to ± 91.5 lbs. per sq. ft.

But the change of pressure due to the decrease or increase of one foot of concrete, less buoyancy, would also be ± 80 lbs. per sq. ft. so that for all depths x feet *greater* than 24 ft. the previous values of R would become as follows:

Compression side, + 12,346 + 171.5 x per sq. ft.
Tension side, + 1,034 − 11.5 x per sq. ft.
And for all depths *less* than 24 ft. R would become:
Compression side + 12,316 − 171.5 x per sq. ft.
Tension side + 1,034 + 11.5 x per sq. ft.

As long, therefore, as the sub-base is embedded in sand enough to fix it (14 ft.) there can be no tension produced in any part, and the greatest compression under this condition would only be
(12,316 + 50) × 171.5 = 20,921 lbs. per sq. ft. = 145 lbs. per sq. in.

We therefore see that, not only is our monolith free from strains exceeding good and accepted practice on the assumption of a depth of water of 24 ft., but also for the totally improbable depth of 50 ft. It only remains therefore to determine the increased pressure induced upon the bearing surface by these moments.

The monolith being fixed by the passive resistance of the sand, the greatest pressure by square foot, will be that due to the above maximum moment, 35,552,400 ft. lbs.

Dividing this by $\frac{I}{S} = 6{,}285$, for cross-section of the monolith, we get 5,656 lbs. as the additional pressure per square foot on the timbers of the caisson. In the same manner dividing by $\frac{I}{S} = 13{,}500$, for the base of caisson, we get 2,633 lbs. as the additional pressure per square foot on base of caisson. Adding these to the pressures due to loads we get:

For pressure on timber of caisson,
8,767 + 5,656 = 14,423 lbs. = 6.44 tons.
For pressure on base,
5,480 + 2,633 = 8,113 lbs. = 3.62 tons.

These loads are all within good practice. The timber in the caisson of the St. Louis and Brooklyn Bridges, is loaded to 10 and 12 tons per sq. ft.

Even these pressures above determined are too high, as no allowance has been made for the very large factor of the sand friction—a factor which becomes a very important one in considering the possible depths to be sunk.

During the sinking a low estimate of the friction against the monolith and caisson for a depth of sand of 50 ft. would be 650 lbs. for each square foot of exposed surface. This becomes, no doubt, much larger after the sand has settled firmly and closely about the structure. Estimating, however, only at 650 lbs. we get for the exposed surface = 6,690 sq. ft., a total frictional resistance of 4,342,000 lbs., equal to 2,000 lbs. for each square foot of the base.

Having shown, therefore, that under the most extreme assumptions, exceeding all possible expectations, our structure is secure and is not subjected to any strains or pressures beyond good and accepted practice, there can be no reasonable doubt in regard to it, when properly founded and protected by a well consolidated bank of massive rip-rap extending up to low water mark.

PERSONALS.

Mr. A. DUFFY has been appointed Assistant City Engineer of Omaha, Neb.

Mr. L. D. WASHBURN, a civil engineer of Minneapolis, Minn., was drowned July 30.

Mr. F. E. MERRILL has been appointed Superintendent of the St. Louis & San Francisco Ry.

Mr. W. H. HARTMAN has been appointed General Superintendent of the Midland Ry., Indiana.

Mr. RUDOLPH HERING, M. Am. Soc. C. E., will prepare plans for the sewerage of East Portland.

Mr. E. WABRAD has been appointed Superintendent of the new water-works now being constructed at Ashland, Ore.

Prof. J. B. JOHNSON, of St. Louis, and Mr. RUDOLPH HERING, of New York, have prepared plans for the sewerage of Key West, Fla.

Mr. L. F. GOODALE, Acting Chief Engineer of the Hannibal & St. Joseph R. R. and the Kansas City, St. Joseph & Council Bluffs R. R. has been appointed Chief Engineer of these lines.

Mr. H. J. DAVISON died on board the steamship *Majestic* July 22. He was born in New York in 1835 and entered the Chelsea Iron Works in this city at the age of 17, remaining with this firm until it dissolved. He then took charge of the Novelty Iron Works and afterward began building sectional steamers for South America. During the last 15 years he has been chiefly engaged in building gas plants.

General SILAS SEYMOUR died in this city July 15. He was born in Stillwater, N. Y., in 1807. His first engineering work was on the Erie Ry. He designed the famous Portage Bridge over the Genesee River, and afterward acted as Chief Engineer of the line. In 1855 he was elected State Engineer of New York. In 1862 he was appointed Chief Engineer of the Washington Aqueduct, and in 1864 became Consulting Engineer of the Union Pacific Ry. In 1872 he was appointed Chief Engineer of the North Shore R. R. of Canada, and later became President of the Massachusetts Central R. R., Consulting Engineer of the New York, West Shore & Buffalo R. R., and in 1881 State Engineer for a second term. At the time of his death he was Consulting Engineer of the Cape Cod Ship Canal.

NEW PUBLICATIONS.

REPORTS.

—*Catalogue of the University of Wisconsin*, 1889-90. Madison, Wis. 8vo., pamph., pp. 188.

This university is one of rapidly increasing importance. It now numbers 789 students in all courses, 113 of them in engineering. It confers the degrees of B. S., B. C. E. and B. M. E.

—*Annual Statements of the Railroad and Canal Companies of the State of New Jersey*, together with the Report of the State Director of the United New Jersey Railroad and Canal Co., for the year 1889. 8vo., pp. 319.

Had the information in this volume been digested it would have been of some value. No attempt at digest or analysis is made.

—*Transactions of the Arkansas Society of Engineers' Architects and Surveyors.* Vol. III. November, 1889. 122 Allis Building, Little Rock. F. J. H. RICKON, Secretary. Pamph., pp. 87; 50 cents.—The society consists of 92 members, 14 of which are in a "student" grade. It is evidently a live organization, and there are two or three very good papers in this volume, and a description of a light camp cook-stove which we may reproduce.

History of Education in Alabama, 1702-1889. By WILLIS G. CLARK. Pub. Doc., Bureau of Education 8vo, pp. 281.

—*History of Federal and State aid to Higher Education in the United States.* By FRANK W. BLACKMAR, Ph.D. Pub. Doc., 8vo, pamph., pp. 343.

This monograph contains a great deal of valuable information, with the usual fault of such government publications, that it is diffuse, ill-digested, and wholly without any general summary of conclusions or facts. As might be expected, it is likewise without an index.

TRADE PUBLICATIONS.

—*The Cook Well Co.* Catalogue of tube and artesian well supplies. The Cook system is in use to supply water for 13 water-works in Nebraska and four in Illinois.

—*Hydraulic Cements*, Natural and Artificial. Their Comparative Values. Paper read before the Society of Arts, Mass. Inst. Tech., by U. CUMMINGS, Buffalo, N. Y., Gen. Supt. Standard Cement Co., Hartford, Conn.

—*Civil Engineers' and Surveyors' Instruments*, 1889. W. and L. E. GURLEY, Troy, N. Y.

We are pleased to note among the novelties mentioned one sensible change from the customs of 30 years ago; the verniers, instead of being placed at right angles to the axis of the telescope, are on a line at an angle of 30° with it, so that they can be read without change of position. Other makers may be doing the same thing, but this is the first time we have observed this very proper change from old practice was in use. In the field it results in great inconvenience at times to have to step around to the side of the instrument to read the vernier.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIV. Saturday, August 2, 1890.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS

CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS

GEO. H. FROST..... .....BUSINESS MANAGER

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COMING TECHNICAL MEETINGS.

Engineers' Club of Kansas City, Mo.—Next meeting Aug. 4. Secy., Kenneth Allen, 200 Baird Building.

Western Society of Engineers, Chicago, Ill.—Next meeting, Aug. 5. Secy., J. W. Weston, 230 La Salle St.

American Society of Civil Engineers, New York.—Next meeting, Aug. 6. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Next meeting, Aug. 6. Secy., W. H. Bryan, 30 South 7th St.

Civil Engineers' Club, Cleveland, O.—Next meeting, Aug. 12. Secy., C. O. Palmer, 22 Cedar Ave.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, Aug. 13. Secy., J. C. Herring, Wichita.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, Aug. 14. Secy., Olin H. Landreth, Vanderbilt University.

Engineers' Club of Philadelphia, Pa.—Next meeting, Aug. 16. Secy., Howard Murphy, 1122 Girard St.

Engineers' Society of Western Pennsylvania.—Next meeting, Aug. 19. Secy., S. M. Wickersham, Pittsburg, Pa.

Engineers' Club of Cincinnati, O.—Next meeting, Aug. 19. Secy., J. F. Wilson.

New York Railway Club.—Next meeting, Aug. 21. Rooms, 113 Liberty St.

Association of Civil Engineers, Dallas, Tex.—Next meeting, Sept. 5. Secy., E. K. Smoot, Elm and Austin Sts.

American Society of Railway Superintendents, Boston, Mass.—Annual meeting at New York on the day preceding the fall meeting of the General Time Convention. Secy., C. A. Hammond, 350 Atlantic Ave.

PERHAPS the most interesting and significant fact in the advance-proofs of the introduction to Poor's Manual, from which abstracts appear in another column, is the continued and heavy growth of the average freight train load. In 1880 it was but 129 tons, the average train load in 1870, for which no trustworthy records exist, having probably been in the neighborhood of 80 or 90 tons. In 1885 it had increased to 143 tons, an increase of 14 tons or nearly 11 per cent. in five years. In 1889 it had increased to 157 tons, an increase in four years of 14 tons more, or of 22 per cent. from 1880. In the last 20 years the average freight train load in the United States has very nearly, if not quite, doubled.

In broad contrast with these figures, the average freight train load in Great Britain, as estimated by Mr. E. B. DORSEY on the basis of 1d. per mile average freight rate (which is generally admitted by English authorities to be as accurate an estimate as can be made), was 71 tons in 1883, and only 70 tons in 1887. The comparison should be a fair one, in any case, and the absolute figures are probably but little in error. The broad contrast is clear, that whereas our train loads yearly go up, and our freight rates yearly go down, both at a rapid rate, there is no discoverable tendency in Great Britain toward a like improvement. Passenger train loads remain nearly constant and nearly alike in both countries, fluctuating between 40 and 43 passengers per train.

IT is not often, even in this age of mechanical progress, that an engineering journal has the chance to describe what has been truly designated by a high authority as an "epoch-making invention." We give in another column the fullest description which has yet appeared in English of the results and effects of such a process, now known as the MANNESMANN process of rolling weldless tubes, which is certainly one of the most striking examples on record of successful "scientific use of the imagination." It accomplishes the apparent mechanical paradox of expanding a solid block of metal into a hollow sealed tube, with a void within several times its own original mass, by pressure applied from the outside; and this it does with great certainty, ease and quickness. To do this, it must of necessity create a vacuum within, unless some gas enters it from or through the iron; and this latter actually happens, the interior space being found to be full of almost chemically pure hydrogen gas at a pressure of about $\frac{1}{10}$ atmosphere. At first thought this seems more than mysterious, but it is less so when we remember that nearly all iron and steel has a large amount by volume (not, of course, by weight) of "occluded" hydrogen within it, which the process seems to set free and convert into its original gaseous volume. The nature of the process we will not attempt to outline again here, but when it is once explained the rationale of it is easily enough understood, like that of the gyroscope and injector. To comprehend what has been done and to conceive of the possibility of doing it, however, are two very different things; as are also imagining a process and actually carrying it out. Both have been accomplished by the inventor, and the process is now a commercial one, there being already five different works using it, one in Wales, three in Germany and one in Hungary. A large amount of power is required, but the process is rapid, and what is more to the purpose, the product superlatively good. It appears to be something to which American inventors and manufacturers might well turn their attention, since the first plant is probably capable of much improvement.

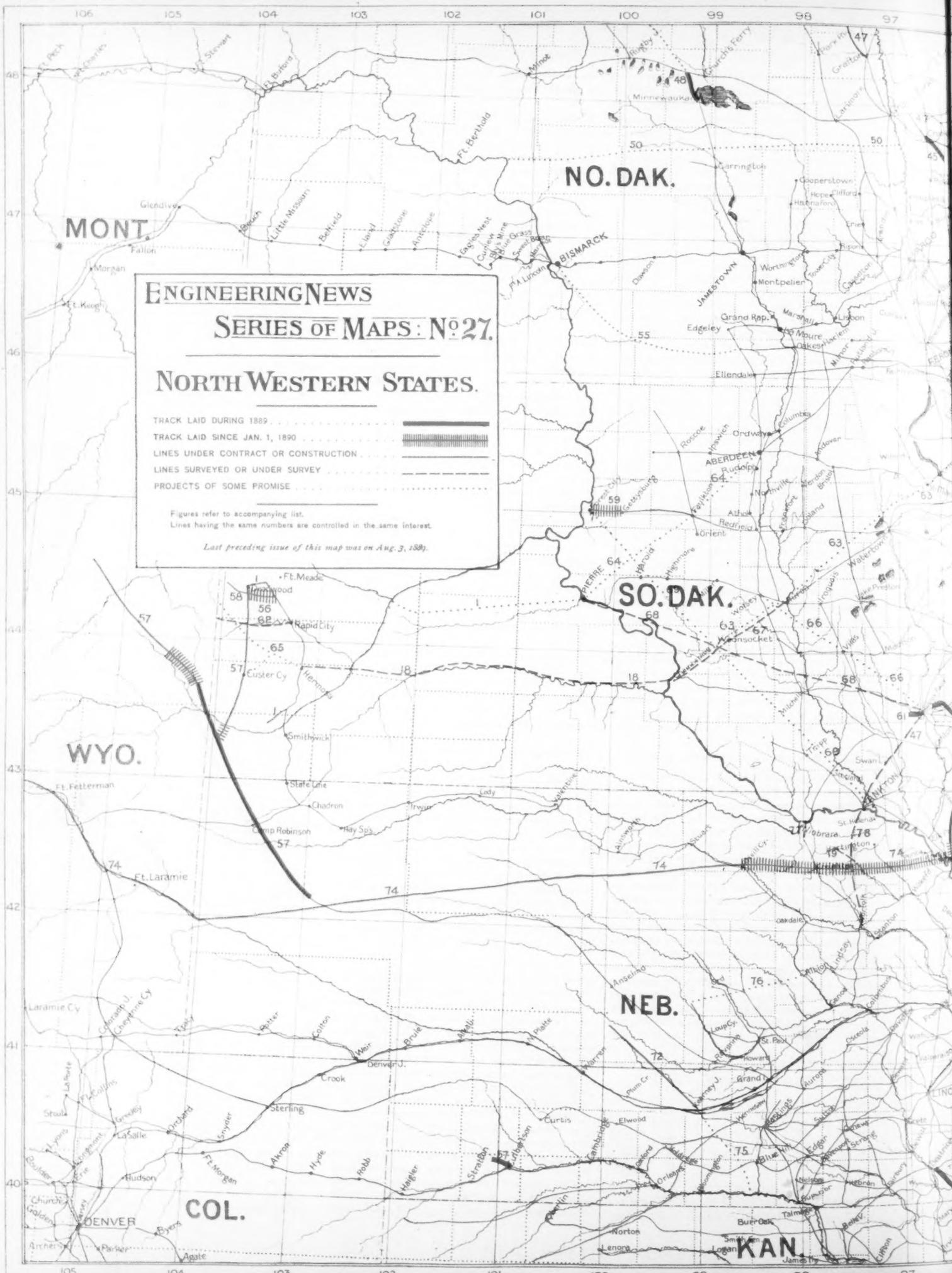
WHAT looks very much like a particularly mean case of plagiarism appears in the last issue of the *Centralblatt der Bauverwaltung*, which, as an official publication of high character, is undoubtedly itself guiltless. One Herr C. WEYRICH, architect for the Dock Department of Hamburg, contributes to it what looks like a very learned article on nickel steel and chrome steel, which, in good part, is a literal translation from pages 368-371 of Mr. H. M. HOWE'S recently issued and masterly treatise on "The Metallurgy of Steel." Mr. HOWE throughout his work gives frequent references to the multitudes of authorities which he has consulted, and such authorities were, of course, equally open to Herr WEYRICH or any other writer; but we look in vain for any reference to Herr WEYRICH among the list of authorities quoted, as also for evidence in his article that he had any other source of inspiration or knowledge than Mr. HOWE'S treatise, from which his whole article seems to be paraphrased when not literally translated, but to which he carefully avoids making any allusion. Herr WEYRICH is thus for the moment enjoying a cheap reputation for an unusually complete knowledge of an intricate subject, but it is a reputation which we hope the *Centralblatt* will aid us in reducing to its proper dimensions.

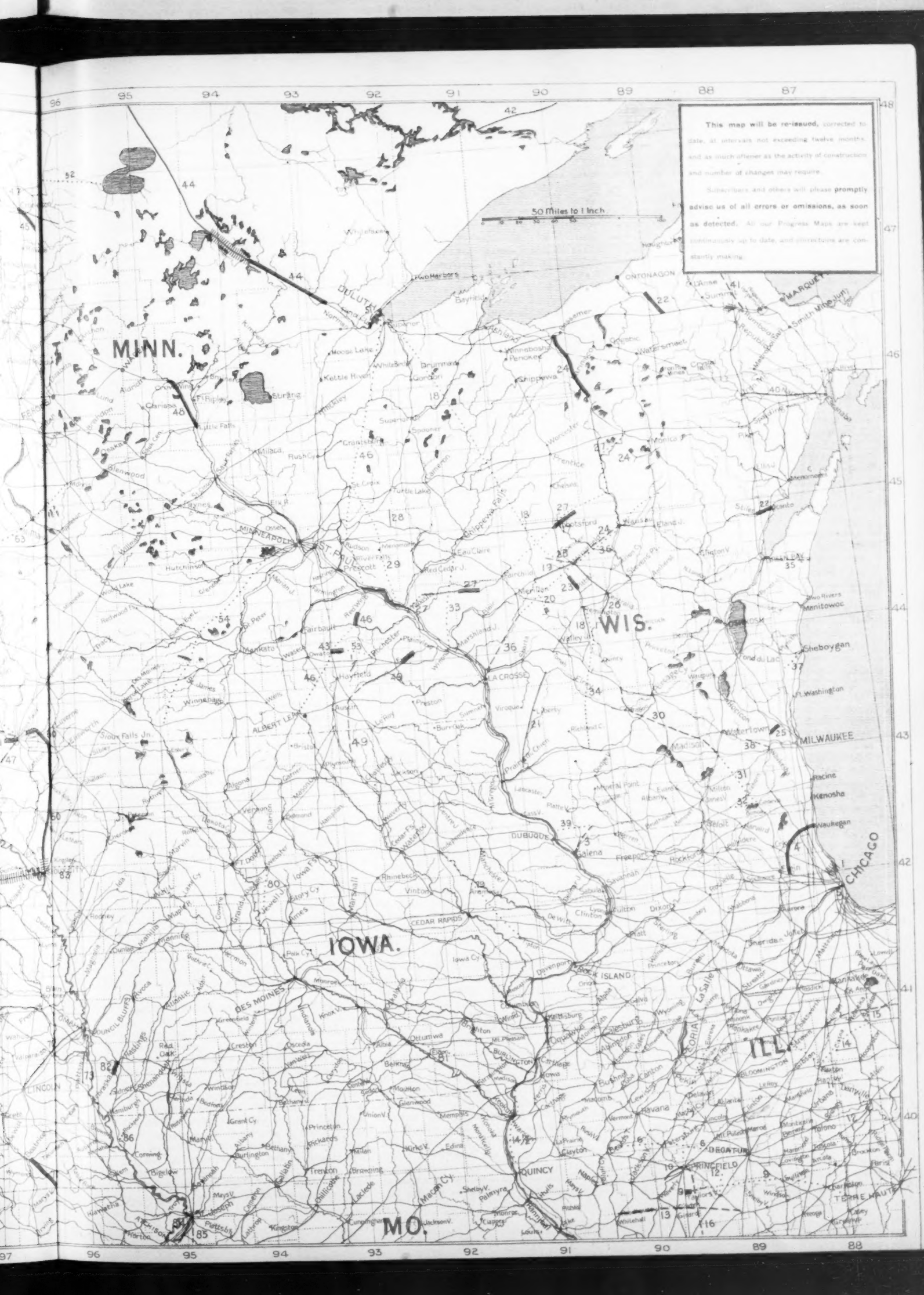
WHILE speaking of Mr. HOWE'S "Metallurgy of Steel," we feel that something more than the usual recognition of the reviewer is due to its exceptional merit. Not since the appearance of DRINKER'S "Tunneling" has any engineering work appeared which has inspired us with such respect for the author, and this work is more meritorious than that in the proportion that the metallurgy of steel is a more intricate and complicated subject than that of tunneling. It is not alone that Mr. HOWE has, with almost endless labor, classified and extracted the pith from the vast mass of English and foreign literature about steel, but he has added greatly to the value of this by extended personal investigations among the steel mills and the practical steel men which have enabled him to digest this mass intelligently, and add to almost every chapter much of practical value which has not heretofore appeared in the literature of the subject. The result is dozens of articles on different phases of the steel question which are of quite unequaled completeness and value, taking them as a whole; and these combined make a magnificent treatise, which will, no doubt, speedily become antiquated from the progress of the art, unless it is kept up to date, like almost every other treatise of the kind in these days of rapid progress, but which for that very reason is at this time not only the best, but the only one known to us in any language which adequately summarizes present knowledge and practice as to steel. Every user in steel in any form should study it if he wishes to use that material intelligently. We have already given a brief notice of the treatise and shall hereafter review it more in detail; but in the meantime it affords us pleasure to give this special recognition of such thorough and good work.

Railway Construction in the Northwest.

There is a prevalent opinion that new railway construction has almost ceased in the section of country covered by the map and statistics published in this issue; and while this idea is by no means a correct one, it is true that construction has fallen off to a great extent. To one who has followed the history of Northwestern railways during the past three years it seems remarkable that any capital can be found to invest in railway building in that section. Over-construction, hostile State legislation, and long and disastrous rate wars have each played their part in reducing profits and making uncertain the outlook for the future. Nevertheless there are still opportunities for a profitable investment of capital in railway enterprises in the Northwest, and will continue to be for many years. That these opportunities are being taken advantage of, notwithstanding the somewhat discouraging outlook, is shown by the following table:

STATES.	Track laid.		Under contract or construct'n.	Located and under survey.	Projects of some promise.
	1889.	To date in 1890.			
Ill.....	127.2	82.2	77 6	308.5	1,200.7
Wis.....	109.4	.....	193.15	294.5	761.
Man.....	362	63.4	297.5	793.	917.5
Minn.....	136.1	.....	175.	75.	447.
N. Dak...	18.	.....	32.	.....	375.
S. Dak...	67.24	32 5	35.	623.2	535.
Neb.....	112.24	166.5	65.9	102.	125.
Iowa.....	78.79	7.77	.....	.....	193.
Total .	1,010.88	353.37	876.15	2,196.2	4,854.2


ENGINEERING NEWS
SERIES OF MAPS: No. 27.
NORTH WESTERN STATES.
TRACK LAID DURING 1889
TRACK LAID SINCE JAN. 1, 1890
LINES UNDER CONTRACT OR CONSTRUCTION
LINES SURVEYED OR UNDER SURVEY
PROJECTS OF SOME PROMISE
Figures refer to accompanying list.
Lines having the same numbers are controlled in the same interest.
Last preceding issue of this map was on Aug. 3, 1889.
MONT.
NO. DAK.
SO. DAK.
WYO.
NEB.
COL.
KAN.
BISMARCK
JAMESTOWN
ABERDEEN
PIERRE
DENVER
Ft. Meade
Rapid City
Custer Cy
Smithwick
State Line
Chadron
Ray Sps
Camp Robinson
Ft. Fetterman
Ft. Laramie
Laramie Cy
Cheyenne Cy
Denver J.
Crook
Sterling
Ft. Morgan
Hudson
Akron
Hyde
Robb
Hagler
Stratton
Curtis
Elwood
Cambridge
Oxford
Orleans
Bloomington
Franklin
Norton
Lenora
Logan
Buer Oak
Talmage
Nelson
Superior
Hebron
Fairbury
Wymore
Blue Hill
Edgar
Fairfield
Strang
Clay Center
Hastings
Kenesaw
Aurora
Grand I.
Howard
St. Paul
Loup Cy
Ansley
Arcadia
Litchfield
Oakdale
Norfolk
Madison
Lindsay
Albion
Columbus
Genoa
Schuyler
Fremont
Scribner
Hooper
Waterloo
Omaha
Council Bluffs
Lincoln
Beatrice
Crete
Wahoo
Ashland
Plattsmouth
Nebraska City
Tabor
Red Oak
Shenandoah
Clarinda
Creston
Corning
Villisca
Stanton
Pilger
Wayne
Laurel
Wakefield
Dixon
Ponca
Hartington
Randolph
Wisner
Pender
Emerson
Concord
Coleridge
Belden
Crofton
Niobrara
Verdigre
Creighton
Bloomfield
Wausa
Ewing
Neligh
Oakdale
Tilden
Battle Creek
Meadow Grove
Madison
Norfolk
Stanton
Pilger
Wayne
Laurel
Wakefield
Dixon
Ponca
Hartington
Randolph
Wisner
Pender
Emerson
Concord
Coleridge
Belden
Crofton
Niobrara
Verdigre
Creighton
Bloomfield
Wausa
Ewing
Neligh
Oakdale
Tilden
Battle Creek
Meadow Grove
Ft. Berthold
Minot
Minnewaukan
Carrington
Cooperstown
Hope
Clifford
Hannaford
Erie
Ripon
Towner City
Casselton
Larimore
Grafton
Park River
Glenullen
Morgan
Ft. Keogh
Fallon
Glendive
Brockton
Little Missouri
Bellfield
Eland
Gladstone
Antelope
Eagles Nest
Curlew
Black Mine
Bald Grass
Sweet Briar
Ft. A. Lincoln
Dawson
Worthington
Montpelier
Edgeley
Grand Rap.
Marshall
Lisbon
Ellendale
Oakes
Glacier
Milnor
Hankard
Ordway
Columbia
Roscoe
Ipswich
Andover
Bristol
Gordon
Northville
Rudolph
Athol
Redfield
Orient
Faulkton
Groton
Leola
Highmore
Harold
Wolsey
Huron
Wessington Springs
Miller
Woonsocket
Artesian
Wessington
Tripp
Mitchell
Letcher
Corsica
Parkston
Swan Lake
Viborg
St. Helena
Hurley
Lennox
Canton
Elk Point
Vermillion
Yankton
Meckling
Lesterville
Irene
Wakonda
Gayville
Volin
Hudson
Chancellor
Alcester
Beresford
Canton
Lennox
Hurley
Viborg
Parker
Agate
Byers
Golden
Church
Arvada
Boulder
Longmont
Erie
Lafayette
Ft. Collins
Greeley
Windsor
Loveland
Berthoud
Snyder
Akron
Hyde
Robb
Hagler
Stratton
Curtis
Elwood
Cambridge
Oxford
Orleans
Bloomington
Franklin
Norton
Lenora
Logan
Buer Oak
Talmage
Nelson
Superior
Hebron
Fairbury
Wymore
Blue Hill
Edgar
Fairfield
Strang
Clay Center
Hastings
Kenesaw
Aurora
Grand I.
Howard
St. Paul
Loup Cy
Ansley
Arcadia
Litchfield
Oakdale
Norfolk
Madison
Lindsay
Albion
Columbus
Genoa
Schuyler
Fremont
Scribner
Hooper
Waterloo
Omaha
Council Bluffs
Lincoln
Beatrice
Crete
Wahoo
Ashland
Plattsmouth
Nebraska City
Tabor
Red Oak
Shenandoah
Clarinda
Creston
Corning
Villisca
Stanton
Pilger
Wayne
Laurel
Wakefield
Dixon
Ponca
Hartington
Randolph
Wisner
Pender
Emerson
Concord
Coleridge
Belden
Crofton
Niobrara
Verdigre
Creighton
Bloomfield
Wausa
Ewing
Neligh
Oakdale
Tilden
Battle Creek
Meadow Grove


This map will be re-issued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.
Subscribers and others will please promptly advise us of all errors or omissions, as soon as detected. All our Progress Maps are kept continuously up to date, and corrections are constantly making.
50 Miles to 1 Inch.
MINN.
WIS.
IOWA.
ILL.
MO.
MINNEAPOLIS
ST. PAUL
DULUTH
LA CROSSE
DUBUQUE
CEDAR RAPIDS
DES MOINES
ROCK ISLAND
MILWAUKEE
CHICAGO
QUINCY
SPRINGFIELD
DECATUR
TERRE HAUTE
ONTONAGON
MARQUETTE
Two Harbors
Sheboygan
Racine
Kenosha
Waukegan
Manitowoc
Fond du Lac
Janesville
Beloit
Freeport
Galena
Rock Island
Davenport
Burlington
Ottumwa
Keokuk
Peoria
Bloomington
Decatur
Springfield
Terre Haute
Quincy
Hannibal
St. Joseph
Council Bluffs
Sioux Falls
Rochester
Winona
Red Wing
Hastings
Stillwater
Duluth
Superior
Ashland
Wausau
Oshkosh
Madison
Janesville
Beloit
Rockford
Aurora
Joliet
Chicago

Comparing the totals here shown with those accompanying the last preceding issue of this map, we have the following results at the dates named:

	Under construction.	Under survey.	Projected.
Aug. 3, 1889	1,258	1,933	4,939
Aug. 2, 1890	876	2,196	4,854

These figures indicate on their face, that, while the prospects for the next two or three year's construction are as good as they were a year ago, the current year's construction is likely to fall below that of 1889. But the outlook for this year's construction is more favorable than the above showing indicates. Of the 1,258 miles under construction at this time last year, work was actually in progress on not more than 800 miles. Of the 876 miles now under construction a very large proportion is being actively pushed by the great companies, and so has plenty of capital behind it. The local and independent enterprises also are generally on a better financial basis than last year.

More track has been laid this year in every State, except Wisconsin and Minnesota, than had been laid at this time a year ago, and the total for all the States is nearly three times as great, viz., 352 miles, as compared with 122 miles. Nearly one-half of this was laid by one company, however, the work of construction being mostly done last year, and it is misleading, therefore, to take this showing as indicative of a probable large mileage to be completed during 1890. The above ratio of increase, however, is not likely to be kept up, and it seems likely that less track will be laid in 1890 than in 1889, rather than more.

As for the prospects for future construction, many of the vexed questions concerning the control of railways by the Government and by their owners will have to be settled, and settled permanently, before it can be prophesied what new work will be undertaken. Many miles of railway are yet needed to fully develop these great grain growing and lumber producing States; and these will be built as soon as some of the present vexed questions above noted are definitely settled.

No better indication of the conservative policy of the railways in the matter of new construction could be found than the tracklaying in 1889 as shown on our map. With only a few exceptions it consists of short branches and extensions scattered over a wide area, and it shows none of that grouping observable when competition is active in opening up new sections of country. The new lines consist of branches and feeders to develop local business, and extensions to make needed connections and form short routes for through traffic. Only three pieces of track 50 miles or more in length were built in the States covered by our list during 1889. They were the 160-mile extension of the Burlington & Missouri River R. R. to the Wyoming coal fields, and the lines built by the Sioux City & Northern and the Duluth and Winnipeg companies, both independent local enterprises. In Manitoba and the other Northwestern Canadian Provinces, which lie outside the limits of our map, construction was more active last year, and several important lines were built by the Canadian Pacific and its recent competitor the Northern Pacific & Manitoba.

Taking up somewhat briefly the new lines in detail, we find a considerable activity in Illinois, mostly in the southern portion and outside the limits of our map. These roads will be shown on our map of the Southwestern States. The extension of the Indianapolis, Decatur & Western to Beardstown is one of the most important lines and will probably be built; but it is doubtful if any work is done this year. The old St. Louis & Chicago Ry., which defaulted early in 1889, has been reorganized as the North & South Ry. of Illinois, and there is a possibility of work being resumed on its extensions north to Eureka and south to St. Louis.

Further south the Centralia & Chester has a line partly graded between Coulterville and Centralia, work upon which is likely to be resumed. The Louisville, Evansville & St. Louis has completed its line from Belleville to Mt. Vernon, laying 49 miles of track this year; and work on the extension of the Chicago, Peoria & St. Louis to St. Louis is making good progress, the line being now completed as far as Edwardsville. Of the other enterprises, the Chicago & Ohio River has a line to Paducah projected, and a short line from Sidell to Fairmont under survey; the Chicago & Northwestern has completed a short line from Montrose to North Evanston, and the Pawnee Co. has surveyed a short extension and may do a small amount of work. Of the projects, the Pana & Roodhouse, the Chicago, Danville & Northern, and the Quincy, Keokuk & Chicago seem the most likely to do any work.

Passing north into Wisconsin, the Chicago, Milwaukee & St. Paul, the Wisconsin Central and the Milwaukee, Lake Shore & Western have each one or two short lines under construction or surveyed into timber districts, and the last-named company has a line projected to Superior, Wis., to connect with the railways centering at Duluth. The Sault Ste. Marie & Southwestern completed a 14-mile extension last year and partly graded 23 miles more, upon which work may be resumed soon. There is little prospect of any work being done on the extension to Rhinelander. Of the other independent enterprises, the Kickapoo Valley & Northern has an 80-mile line under contract and is likely to do some work soon. The old Chicago, Lake Geneva & Pacific scheme has been revived and has some prospects of success; and the Chicago Baraboo & Northern, the La Crosse, Black River Falls & Eastern and the Kewaunee, Green Bay & Western companies have lines surveyed and intend to let contracts shortly. The only other railway in this section upon which any work is being done is the line being built to give the Schlesinger iron mines an independent outlet to a lake port at Escanaba. Work is being actively pushed on this road, and the greater portion will probably be completed this year.

Construction in Minnesota is confined to a few companies. The Duluth & Winnipeg has recovered from its legal and financial difficulties, and is pushing work on its extension to the International boundary, where it is to connect with a road to be built southeast from Winnipeg, Man. The Great Northern is constructing a short branch in the northwestern part of the State, and the Winona & Southwestern has a further extension of its line under construction. There is little prospect of any immediate work being done on the various projected lines, with the exception of the Duluth Transfer Ry., which is likely to be put under construction this year.

No active work is in progress in North Dakota. The Great Northern has a line graded from Grafton to Cavalier, 33 miles, and intends to lay the track this season, and this is probably the only track that will be laid during the year. The Northern Pacific proposes to extend the Jamestown & Northern R. R. north from Leeds at some future date, and the Minneapolis, St. Paul & Sault Ste. Marie will probably build to Bismarck in the course of one or two years; there is little indication, however, of any work being done soon.

In South Dakota construction is more active, and several important enterprises are under way. The Burlington & Missouri River and the Chicago & Northwestern have lines under construction in the Black Hills region, and the Chicago, Milwaukee & St. Paul is surveying a line to the same section. Several local enterprises are also under way there. Farther east the Gettysburg & Southeastern has laid 16 miles of track. The possibilities of a lucrative traffic from the settlement of the Sioux Indian Reservation has given rise to several projected lines into that section. Most of these are in an embryonic condition, however, and few of them will ever be constructed. The large companies which control practically all Dakota's mileage have an eye on this section, and will probably build all necessary lines as soon as the prospects of a paying business will justify their construction.

The most important enterprise in Nebraska, and indeed, the largest live railway enterprise in the country, is the Pacific Short Line, projected from Sioux City, Ia., to Ogden, Utah, 934 miles. A section of 128 miles, to O'Neill, Neb., has been completed, and the contract for the remainder has been let to Scullen & Steacy, of St. Louis. Work has not been commenced yet, however, and there is no certainty that it ever will be. The enterprise claims to be an independent one, and is represented by the Wyoming Pacific Improvement Co., of New York City; but it is pretty certain that behind the company are heavy stockholders or officers of one or two of the large systems which will form the road's eastern connections. Its route is about 100 miles north of the Union Pacific Ry., and it will provide for a similar class of traffic.

In the southeastern portion of Nebraska three lines are under construction, the most important of which is the extension of the Chicago, Rock Island & Pacific R.R. from Omaha to Lincoln. The Kearney & Black Hills Co. is building a road from Kearney northwest, and the Omaha Southern is working on a short line from Union to Plattsmouth. In the north the Chicago, St. Paul, Minneapolis & Omaha has surveyed a short extension from Randolph northwest, and the Niobrara & Sioux Reservation Co. proposes to regrade and lay track on the 12-mile line between Verdigris and Niobrara. Farther west the Burlington & Missouri R. R. was completed into Wyoming last year and a further extension is now being made.

Practically nothing is being done in Iowa. Of the four projected lines, the extension of the Chicago, Ft. Madison & Des Moines is the only one which has much prospect of being built. Last year's tracklaying consisted of the Sioux City & Northern, the longest independent line built in this section, and the Tabor & Northern R. R., a short local road.

In the portion of Missouri shown on our map, the extension of the Chicago, St. Paul & Kansas City from St. Joseph to Leavenworth is the most important.

Construction in the Canadian Provinces which we include in our list is quite active. The Canadian Pacific is pushing several lines, and the Great Northwest Central, the Manitoba & Northwestern, and the Port Arthur, Duluth & Western will each do considerable building this season.

Viewing now the progress in the whole Northwest, it must be said to be more active than would be expected considering the general condition of affairs. In a large part of the territory shown on our map, short branches for local business are the only roads needed, and these are being built in considerable numbers. In other sections extensive construction is not warranted by the amount of traffic to be at present obtained.

On the whole the people of the Northwest may congratulate themselves that so much capital is being invested in their section when they have done so much to frighten it away. If they wish at any time to secure still better transportation facilities, they have but to adopt some plan for equitably and permanently settling the vexed questions as to the relation of the railway to the State; and if fair security is offered to the capitalist, all the new lines they can support will soon be built.

English and American Boiler Practice.

Our readers will remember that some time ago (March 15, 1890) we noted a certain challenge from *The Engineer* in regard to a discussion of the comparative "all-around" merits of English and American locomotive practice, "beginning with boiler practice." As we then intimated, it seemed as if some profitable meat might be got out of an

investigation of the subject; but, as our contemporary well notes in an article reprinted in another column, what is wanted is not theories but facts, and we therefore announced that we should first take all necessary time for conveniently collecting them. We regret to say that, as respects English locomotive practice, the hunt for definite facts has been so far even less successful than we had hoped. The most elaborate paper which exists on their maintenance and operating expenses relates only to Irish railways, which are notoriously backward in their practice. Detail reports of individual roads, and of the locomotive departments thereof separately, such as are so common in this country, do not there exist. The government reports are a mere skeleton of what such reports should be. It is not even possible to determine what the average work of any of their locomotives really is, for the reason that no ton-mileage or passenger-mileage records are kept, much less reported, by any road in England (in which respect it is behind all other civilized countries), and if car-mileage records are kept they are not published. The very different conditions as respects information about American locomotives are in part admitted by the article from *The Engineer* in another column. It knows of our technical societies' reports, but of the multitudes of individual railway reports which are issued here but not there it does not seem to be aware.

Nevertheless, we have partly overcome these difficulties, and hope to wholly overcome them shortly; but in the meantime hot weather has come upon us. Our contemporary knows little about an American summer, we are sure. Our boiler practice editor finds it hard enough to keep down his own evaporation per square foot of heated surface without worrying much over that of locomotives, and respectfully declines to attempt any heavy statistical articles in the dog days, or to impose them, if written, on long-suffering readers.

In the meantime, moreover, certain other journals, influenced by a more burning zeal than ours for the American locomotive, or, perhaps, by a keener desire to let it be known among men that they had views to express, have picked up the gauntlet that we have treated so leisurely, and their arguments seem to have had such effect on *The Engineer* that it now thinks it can say anything it pleases with perfect impunity. It now has the temerity to produce the article which we reprint in another column as an adequate summary of facts and reasons why the American locomotive is very inferior in respect to its boilers.

But our contemporary has gone too far. We still decline the heavy statistical rôle until the wind blows from a cooler quarter, but we have no objection to a hot weather flyer, containing just enough of statistics to show how much truth and how much error there are in the positions assumed in its last article. For that matter *The Engineer* itself sets us the example of drawing lightly on actual records, contenting itself with merely pointing out how very inferior the English sources of information are to the American, without any attempt to fill this void which, were ours an English journal, we should feel to be incumbent on us. It should know what information can be had in England much better than we; and we now request it to produce the latest data available as to *average* coal consumption, *average* load hauled, *average* yearly time lost in shops, and *average* yearly mileage of engines for the different classes of service and for different individual roads, as well as for the nation. We would prefer to use admitted facts rather than our own estimates as a basis for discussion.

Our contemporary opens by "asserting" that American bituminous locomotives "do not evaporate more than 5 to 7 lbs. of water per pound of coal, while English locomotives evaporate from 7 to 12 lbs." This is not so very far out; simply a little exaggerated in opposite directions. The present writer devoted much labor some years ago to determining these same facts, and gave as a conclusion: "The ordinary evaporation of water per pound of coal burned is hardly more than 6 lbs. in this country, and sometimes only 5 lbs., or even less, although it rises to 8 or 9 lbs. in some cases, and very frequently, if not usually, it does so abroad, where the evaporation is more economical than is common here, the reason being"—but we will come to the reasons later.

This, however, was written to give a general average of the entire country. It includes much coal of a very inferior quality, having only 75 to 80 per cent. of combustible, used because it is so abundant and cheap. Few of the Western coals are really good. Even the average of Eastern bituminous coal is not quite up to the English average, their coal being nearly all good, what there is of it; but it is nearly enough so for comparison. It gives as good results as anthracite. When burning such coal the evaporation very rarely falls below 6 lbs.; it often rises to 9 lbs. In innumerable special tests 9½ lbs. or more has been claimed. The general American average among the comparable coals varies but little either way from 7 lbs.; is rather over than under that, perhaps.

On the other hand, the locomotive never ran in England, nor in the world, which, as an average of a year's service, or even 1,000 miles service, could show an evaporation of 10 lbs. per pound of coal. We challenge our contemporary to give evidence to the contrary; the burden of proof is upon it. The proof does not exist. That evaporation is equivalent to about 12.1 lbs. from and at 212°, the theoretical evaporation of the very best coal being under 15 lbs. The theoretical evaporation of fair average (14,000 H. U.) coal at boiler pressures is but little over 12 lbs. Much over 75 per cent. of this efficiency cannot be realized, even for a day, in regular service, and nothing over that for a year. We do not forget the STROUDLEY experiments on the London, Chatham & Dover, showing somewhat over 100 per cent. efficiency; *i. e.*, that somewhat more heat units were put into the steam than chemists have yet been able to discover in the coal, leaving nothing for the gases of combustion or for radiation. We exclude all 50-mile tests with evident sources of error. Barring such, evidence for the 10-lb. limit is wholly lacking.

English locomotives do much more frequently than ours run somewhat over 9 lbs., however, and we judge that few burning good coal fall so low as 7 lbs., so that our contemporary's minimum is a proper one. The English average, too, we are disposed to think, is fairly represented by the average of *The Engineer's* limits, 8½ lbs. The evidence as to what it is is lamentably scanty, but it seems to warrant this conclusion; so that English evaporation stands to American, in average practice, as 8½ to 7, or 21 per cent. in excess. We might even admit a little more; we fancy it may average 25 per cent. excess, but this is an outside figure. When we remember that even bituminous slack is worked up to 8½ lbs., and lump coal to 9.6 lbs. in regular service with large fire boxes, this seems liberal, but we believe it is fair. *The Engineer* itself says "25 to 30" per cent., so that we are little apart on this premise.

Now for the reasons: "Various reasons suggest themselves to" *The Engineer*. It "ventures to assert" that the American fireman is not as skillful as his English compeer [he is not]; that he has a soul above firing [he has; not one in ten of them sticks to it many years]; that he lacks the training imparted on English railways [he does; our roads pay much less attention to such training, partly because they have not so docile a scholar]; that he has no special inducement to save coal [he has not, the premium plan not extending itself very fast under our conditions]. On the other hand, the American fireman will average a brighter, more ambitious and more intelligent man, so that the difference is less than appears, but there is a real difference. We judge it to be good for 5 per cent. of the fuel, possibly more.

Our contemporary also thinks it "possible" there is a difference in quality of coal. There is indeed a great difference, taking broad averages, but on the basis to which we have reduced it, very little; and this exhausts *The Engineer's* imagination of possible causes for the difference other than badness of the boilers, which, it "seems to be clear" to it, are "deplorably bad." It is generous enough to surmise that this is not because we cannot, but because we will not "burn coal to the best advantage, for some reason to us inscrutable." This reason we hope to shortly make forever clear, but first we must eliminate *The Engineer's* explanation.

It concludes that the trouble with the boiler "must be" in the fire box; that the trouble with the fire box must be lack of a brick arch, and that the trouble about brick arches is, that they cannot be used except with copper fire boxes. It will surprise *The Engineer* to learn that this brick arch obstacle is purely imaginary; that there is no difficulty in using brick arches with steel fire boxes; that thousands of them are in use in this country; that abundant American experiments of many years standing have seemed to show 10, 20 and even 30 per cent. of fuel economy from them, and none, a loss; and that the American Railway Master Mechanics' Association, two or three years ago, unanimously resolved that they were in themselves a good thing.

The brick arch difference, therefore, cannot be the reason for the international contrast, so many roads using them as to fully establish their net advantage, if there were any, and yet not enough to persuade the remainder to use them. Evidently this latter is because the balance of the *pro* and *con* is pretty nearly even in this country, although it does not seem to be in England. The reasons for this contrast are doubtless many. The arch may make somewhat more trouble with steel than with copper fire boxes, and the addition to and interference with boiler repairs is more serious when engines are expected to make a heavy annual mileage than when they only make a small one; but mainly the difference of practice originates in two facts, as we take it: (1) that it is of less proportionate value in large fire boxes than in small ones, and American fire boxes, especially in freight engines, are usually larger than in the corresponding service in England, being for larger engines; and (2) in a very important reason which we have never seen advanced, but which we suspect to be an important contributing cause, viz., that while the brick arch does increase the evaporative efficiency when the engine is not pushed, it likewise decreases somewhat the maximum volume of steam which can be obtained from a given fire box and boiler by pushing it to its utmost—and that, we shall shortly show, is what the American manager wants and will have, and what either the American or English manager should want and should have.

For here we touch on the all-sufficient reason why there is the difference of fuel economy in question; a reason which *The Engineer*, with very suspicious absence of mind, avoids even alluding to. It is impossible to push either a man or a horse or a boiler to its utmost exertion of power and not cause a certain falling off in "fuel efficiency." To push a man or a horse so is cruel, and for physiological reasons does not pay in the end; but there is nothing cruel in pushing a locomotive to its utmost limit if it pays better to do so. It is a simple matter of dollars and cents, and we shall see that both the dollars and cents and the £. s. d. are enormously in its favor.

Why, then, do not the English do it, both by making a larger annual mileage with their locomotives and by hauling heavier trains? *The Engineer* suggests that they do not haul heavier trains because they do not want to, probably be-

cause no other reason has occurred to it; but that we shall show in a moment, is to put a slight upon the intelligence of the English people which they do not deserve. Whatever their other faults may be, they are not fools. The real reason we have never yet seen suggested, but we judge it to be simply this: It is because they cannot haul heavy trains without an entire reconstruction of their rolling stock, as well as of their habits of operating. The English "goods waggon" (well so called, because it is not so very dissimilar in weight, brake gear, general construction, or strength from one of our heavy "prairie schooners") simply cannot be handled in a very heavy train. In the middle of one of our 40 to 60 car trains it would have hardly more chance than an egg-shell. To handle a thousand or two tons of them in one train, as we do constantly with our freight cars, would result in early and certain grief. But when a long train cannot be handled, short trains naturally tend to run pretty fast, because they can be so run as well as not; and from this it is only a step for thoughtless people to convince themselves that "their traffic requires" fast freight trains and short ones, especially when there is a measure of truth in the claim, as respects a part of the traffic. There is a real difference of conditions. There is not the same pressing necessity there as here to handle much traffic in very heavy trains or not at all. But there is an enormous mineral and general freight traffic of which this is not true at all, and of most of the traffic it is only partially true, so that the English "boiler efficiency," in so far as it is obtained by not pushing engines to their full hauling capacity, is purchased only at heavy loss, which we will now estimate.

The balance sheet stands thus: In England and America alike the cost of fuel for road locomotives (excluding switching service) is only about 7½ per cent. of the total operating expenses per train mile. There is very little discoverable difference in the per centage of expenses in the two countries. On most of the larger roads in both countries it runs below this. Suppose we save 20 per cent. of this 7½ per cent. by burning fuel with the utmost economy; it is only 1½ per cent. of the total expenses. Now, on the other hand, suppose we increase our train-loads 20 per cent., we then save nearly 20 per cent. of the *whole* cost of running locomotives, repairs, fuel, wages, interest account and all; of the *whole* cost of train wages and of a very large part of the cost of maintenance of way and various other expenses. In all, without going into details, about 50 per cent. of the total operating expenses varies directly with the number of trains run to handle a given traffic; so that we have only to add *three per cent.* to our average train load to save more than is saved by the boasted difference in fuel efficiency.

Now the average American freight train load is not merely 3 per cent. or 20 per cent., or 50 per cent. or 100 per cent. heavier than the average English train load, but averages about 2½ times the weight of the English train, the two standing to each other about in the ratio of 70 tons to 157 tons, many trains in both countries being of several times this weight. In part, the contrast is unfair, the conditions of traffic as respects length of haul and other governing conditions being different, a fact which some American controversialists in their turn improperly neglect or belittle. But making all allowance for this difference, and considering only the traffic under fairly parallel natural conditions, there is at the lowest estimate a difference of 50 per cent. in this respect, and probably 75 per cent. This contrast, moreover, tends to increase and intensify itself, the average American train load rapidly increasing, while the average English train load remains stationary.

In passenger traffic there is less cause for difference in average train load. There is a heavy loss as well as gain from cutting down the number of passenger trains, so that there is no tendency to attempt this in this country, but rather to increase the luxury with which the passenger is carried. The average number of passengers per train is about the same in both countries, about 42, but owing to the freer use of heavy drawing room and sleeping cars in this country the average weight of passenger train is very much greater in this country, varying from 30 to 50 per cent. more than trains in corresponding service in England. Hauling this extra weight may be wise or unwise, but it is done deliberately, to attract travel and in response to a public demand. We consider it demonstrable that it is right and profitable; the dead weight question being a very different one in passenger and freight service; but whether this be so or not does not immediately concern us.

It is the general rule in this country, therefore, that both freight and passenger engines are loaded with all they can handle, and in all cases with much larger proportionate loads than for corresponding traffic in England. The Webb compound locomotive imported for trial by the Pennsylvania R. R., for example, proved quite unequal to the demands of their regular service, while answering admirably in England. To meet these more exacting demands for power, there is a difference in our locomotives from the English which the most unobservant ear instantly detects. The English exhaust gives a soft, gentle and almost continuous sound; the American a sharp, tearing, vicious cough, which sounds as if it well might be "cutting the coal," and which causes a considerable waste of fuel; but which nevertheless gets more heat out of a square foot of grate than the softer English exhaust can possibly do. As much as 20 per cent. of the coal put into the fire box has actually been caught unconsumed in the smoke box in cases, besides nearly as much more which may have been blown out of the smoke box. There is undoubtedly a loss of about 20 per cent. of fuel efficiency (much of it a needless loss, no doubt, in cases) to realize this ultimate tractive power; but it is like sowing seed for crops; it comes back again multiplied many fold, and the final result is that the American railway service is the cheapest and best in the world.

The English do not make the same sacrifice to reap a like gain, not because they will not spare the seed, but because they have placed it beyond their power to raise the same crop from it, as we stated above. To reason otherwise, as *The Engineer* does, is to insult their intelligence. Let us suppose it was a question of horse-flesh instead of locomotives; that one man was feeding his horses a peck of oats a day, and that another should upbraid him for his folly by remarking that he only fed a quart of oats a day and yet his horses traveled nearly as far per day and hauled a quarter as much load, so that the "efficiency" of his oats was just double! Such and so foolish is the position of those who laud the English locomotive for sacrificing 55 per cent. of load to gain 20 per cent. of evaporative efficiency. We will suppose that the horses of neither man suffered in condition, or the comparison would fail; but even barring that, should we not remind the economist that there were questions of extra wagons, extra teamsters, extra stables, extra grooming, etc., which he was neglecting in his one-sided economy? Of the like facts in locomotive practice we remind *The Engineer*, and, without noticing other details of its article which invite comment, we leave it to reflect and to repent.

CORRESPONDENCE.

Brick Pavements.

CITY ENGINEER'S OFFICE,
SYRACUSE, N. Y., July 29, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I am quite interested in Mr. CHASE'S paper on brick pavements in your issue of July 19-24. We have nothing of the kind here, except in the matter of sides walks, but there is a proposition now before our Common Council to pave in this manner a street about 3,000 ft. long, road bed 46 ft. in width. The manner of construction which I shall specify if the scheme reaches a head, is practically that in paragraph 3, etc., on page 73 of your last issue. But I shall require in addition brick tile drainage under the curb, and filling all joints of brick with asphaltic cement. We require these in sandstone pavement already. The concrete foundation in which will be set the curbs, will be made as for asphalt pavement.

The items of asphaltic cemented joints and curb drainage applied to the other varieties of pavement described will make any of them substantial and waterproof.

H. W. CLARKE, City Engineer.

A Legal Question as to Pay Accounts.

TO THE EDITOR OF ENGINEERING NEWS.

SIR: I wish to get some information regarding employés' liability for engineers' salaries. The question might, perhaps, be more properly referred to a lawyer, but as it is one which has doubtless been settled a dozen times in similar cases, I have no doubt you can give me the rulings. They will prove of immediate interest to at least ten of your readers down here.

I shall give you the facts and names, but will ask you not to publish either so that they can be recognized:

Three years ago last January the A. & B. R. R. Co. was chartered to build a line of railroad some 200 miles long. The President and Vice-President then chosen still fill those offices. The incorporators were poor men, and little was done except in the way of talk until a year ago last March. Then a firm named C. & D. was organized for the purpose of building the road and received a contract to do so from the company, which in the meantime had changed its name. The firm of C. & D. was to have all the engineering work done, and employed Mr. E., of your city, as Chief Engineer.

A year later, I being then permanently employed by another company in operation, I received an offer of a position from one of the locating engineers. I accepted it, and began work March 10. We received our salaries for March, April and May in due time. The next month we received none, nor the next, but continued working. About two months later work was suspended, the line being then all located and a mile or two of grading done. We were told that the suspension was only temporary, that Mr. C had failed in his private business, and that this affected the firm for the time being, but that our money would be forthcoming in a few days and work would be continued. This was told us by the locating engineer; we have never seen the chief since. When the specified time had expired we were told that Sept. 10 would be the date, then the 20th, and so on until December. Then we were told that our money would be on hand for Christmas, then Jan. 15, and so on until May, when I gave it up and came back to my old road. During all this time I might have had employment elsewhere, but as we had never been paid off or dismissed, but on the contrary were kept on with the promise of speedy resumption, I thought it best to remain. As late as April I received a letter from the chief, which stated, that so far as he could judge, the matter would come out all right in about 60 days.

We do not know Messrs. C. & D., but we have great confidence in the integrity of the President and Chief Engineer. But as we were employed by the C. & D., we cannot well look to the former for our salaries.

What I want to know is whether I have a legal claim against any one up to May, 1890, for my salary; and if so, if this claim can be enforced against Messrs. C. & D., or either of them, and failing them, against the company itself, or if any of them are good for the amount. J. H.

[We speak with diffidence on all legal questions, but our understanding of the case, from the facts stated, is that our correspondent has a perfectly valid and collectable claim against either the firm of C. & D. or Mr. C. or D. individually. Whether he has a claim against the company would depend somewhat on State laws, but morally he has a valid claim against them, and in most of the States we should judge that he would have a legal claim also. If we are wrong in this we hope to be corrected. —ED. ENG. NEWS.]

The Proposed New York-Philadelphia Ship Canal.

MOUNTAIN LAKE, Va., July 22, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of July 19 occurs a reference to the ship canal project between New York and Philadelphia, closing with the comment that "inasmuch as the two cities have already excellent water communication by the open sea, it is a little difficult to see how the proposed canal could be a paying enterprise."

As this note would have the effect of deterring private capital from engaging in a work of great public utility, I beg leave to call attention to the history of the old Delaware & Raritan Canal, as published in my paper on

"Canals and their Economic Relation to Transportation," a copy of which was forwarded to you early in March.

From this it appears that under favorable circumstances there were times when, notwithstanding the excellent water-way by the open sea, there was a traffic on the canal of about 3,000,000 tons, and that the net revenues of this limited channel amounted to $933,643, while the expenses were only $360,514, making the total receipts for one year $1,294,157. The cost of the canal and appurtenances at that time was stated at $4,381,251, so that the traffic on old canal actually paid 21% twenty-four years ago. If it be true that the cost of movement varies inversely as the draught, then the enlarged canal, for a proportional increase of traffic, should pay even more, or, upon the same amount of traffic as existed in 1866, it should pay about 7% on the estimated cost of construction.

Steam vessels having a speed of 12 miles per hour, allowing for the canal transit of 33 miles with locks, could make the trip in about 12 hours, whereas to go around via Cape May requires about 30 hours, and it is not probable that masters and owners would prefer the longer and more dangerous route if the shorter were available. The revenues from increased tonnage, it is believed, would soon far exceed the legal interest on the cost of the improvement, including right of way.

This argument is based upon the maximum profits as they existed many years ago, because it is a fact, and not a hypothesis; and, further, because but for the wilful withdrawal of the traffic, it would have been far in excess of that used as a basis, and it would have long since required an increase in the capacity of the canal to accommodate it. In the opinion of the writer there is hardly a better opportunity for a successful financial enterprise in transportation in the United States.

LEWIS M. HAUPT, C. E.

[Our correspondent certainly makes a strong argument, and we should be sorry to throw any cold water on so important an engineering enterprise, which would have great value for coast defence as well as for purely commercial purposes.—ED. ENG. NEWS.]

The Russell Snow Plow.

111 BOYLSTON ST., BOSTON, MASS., July 25, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: As a representative of the Russell snow plows, which you recently illustrated (July 12) let me say I have read with interest, and no little amusement at times, the articles in other railway journals about the working and tests of the machine plows or "rotaries." I had intended at a later date to enter the arena and "tell the truth and stick to it," as to greater and better work being done by the Russell plows than by any other plow or machine; but since you were enterprising enough to illustrate our plows in your issue of July 12, with commendations of the same, unknown to either myself or partner until to-day, let me ask now for a chance to note a few corrections in the plans, as embodied in our latest plows, and also to state why they have done work never before done.

The first Russell plow began running in 1885, on the Intercolonial. Last winter 17 plows were in use on seven roads, not including a plow recently delivered to the Poughkeepsie Bridge route. Two of these plows are three thousand miles apart. They have handled all kinds of snow up to 15 ft. deep, and the work done justifies us in saying that we have a push plow that may be small or large, and that will hold to the rail, and therefore can be safely run at a high rate of speed.

That the Russell plow will hold to the rail most railway men who are not acquainted with it will not believe. They are more ready to believe what has been in accord with their experience, as you have stated it: "The great trouble with the old type push plow was the persistency with which it went into the ditch whenever it struck an exceptionally heavy drift," and it is because of this evil, in my opinion, that Western railway men have been led to abandon the push plow for the rotary principle, because the rotary would get there some time, if long, and with but little danger of derailment.

In the letter you print from Mr. P. S. ARCHIBALD, Chief Engineer of the Intercolonial Ry., he gives it as his opinion that the merits of the Russell plow lie "in its great strength and excellent workmanship." This remark, I think, is the result of an oversight. If strength and weight are all that is required, why have other than Russell plows failed, some of them larger, stronger and heavier, built in recent years, after much thought, by the leading Western and Northern railways? Why did they not hold to the rail? Why fail to do with six engines what Russell plows have done with three engines? A leading official said to me, a year ago, regarding a big plow his company had built. "I have seen six engines and a plow in the ditch at once." The different result with these plows with their "great strength" and the Russell plow is because the latter plow has a radical difference relating to the application of the power; viz. the propelling power is applied over the king pin in the front trucks by means of a heavy oak timber extending from the rear, and between the sills, to the front, with means at the rear to oscillate when the plow is on curves.

This is the "*Why;*" pushing the plow at the point of resistance from the snow instead of 30 ft. in the rear; at the heavy end of the plow instead of the light end; and when on a curve, in a straight line instead of at an angle The Russell plows have many minor improvements, but this push bar (which in the plan of wing plow you publish is erroneously shown without a space at its sides) is an application of the one principle without which all attempts to build an efficient plow have failed; and is the chief cause of the great success of the Russell plow. Why this is so many times overlooked is because the push bar is out of sight, and so out of mind.

The wing plow dimensions are also somewhat in error. They show the plow 10 ft. 10 ins. wide, and 16 ft. 9 ins. extreme height, whereas it should be 10 ft wide and 14 ft. high. There are few roads upon which a plow as wide as the plans show could be run. Each view of the plow complete should also show the steel plate hooding or fender on top of the center cutter to prevent the snow going over the top.

A word now about the wings. These, when fully extended, take 3 ft. extra cut on each side, making the opening 16 ft. wide. The snow removed by the wings is not first removed by the front of the plow, as one might suppose from your description. The front of the plow lifts a width of 10 ft. of snow and throws it from 40 to 60 ft. away, the wings take 3 ft. more each, and also throw it from 40 to 60 ft. away, and both front and wings operate to elevate the snow and get it out of a cutting. The road may be opened and widened at the same time; but if you are without sufficient power to do both at once, use the wings on your return trip with plow behind engine.

The common wing with its flat, vertical side or face only crowds out the snow, forming a solid wall at the side of the road, and often crowds the plow off the rails or spreads the rails. This wing with the elevators gets under the snow and lifts it up, then throws it out, the pressure being downward upon the rail instead of sideways.

I will be pleased to furnish further information regarding our plows or letters about their working.

J. W. RUSSELL.

[Our recent illustrations of the Russell plows were made from the standard drawings of the International Ry., and our knowledge of their working was obtained chiefly from their performance on that road. Reference to Mr. ARCHIBALD'S letter quoted from in our description of the plow, shows that he gives it full credit for its good behavior in sticking to the track, since he declares specifically that "we feel safe in attaching three of our heaviest locomotives to the Russell plow and running into drifts 5 to 15 ft. deep at a speed of 25 to 35 miles per hour." Certainly unless the plow possessed the attribute of sticking to the track in a most uncommon manner, one would hardly feel "safe" in butting such deep snow at this speed. In our description of the plow attention was called to the heavy push timber and its office; but perhaps not so explicitly as its importance deserves. A push plow which will stick to the track and not collapse when butting deep drifts with three heavy engines behind it, and which can be built complete for one-fifth the cost of a machine-snow plow, is a piece of rolling stock of considerable interest to Northern railway managers. If this plow will stay on the track, not only when butting snow, but when it strikes a side hill drift where one rail is bare and the other has 4 ft. of snow on it packed hard enough to bear up a man, it ought to replace every one of the old fashioned push plows before next winter.—ED. ENG. NEWS.]

A Toronto Washout.

TORONTO, June 28, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR:—I enclose you a photograph of a washout that occurred on Christie St., on the evening of Wednesday June 11, when 1.70 ins. of rain fell in 28 minutes. At the point where the washout occurred there is a ravine on each side of the road about 25 ft. below the crown of the street. The sewer, which is a 2 ft. × 3 ft. 9 in. work, is 15 ft. deep. At this spot the soil is sand and gravel; the gulley on the left-hand side of the view was unable to take all the water which ran over the edge of the hill and it gradually excavated a channel which let the 6 in. water main down. This added to the storm water, completed the mischief. The sewer was constructed during the winter of 1889, the brick being laid in Portland cement, mortar 3 to 1. It will be seen that the earth is completely washed away from under a considerable portion of the sewer, but from levels taken the next day I found that the sewer had not settled in the least. The brick catchwater basin on the left of the picture fell to the bottom of the ravine without breaking. I think all this shows evidence of good work. I may add that the sewer was running half full for some time, but no evidence of any leakage could be detected.

C. H. RUST,
Eng. in charge of sewers.

A WASHOUT AT TORONTO, ONT.

[We engrave the view herewith.—ED. ENG. NEWS.]

Notes and Queries.

J. T. F. writes: The Water Co. are digging a reservoir in clay soil, 150 × 70 × 10. In a few places there is sand in the bottom, and on the sides, in a few places, a kind of small rotten stone, the largest not larger than a brick. What is the cheapest way to make it water-tight? Can it be done by taking out the sand and rock and filling back the clay? [This is one of a class of questions which we seldom attempt to answer in these columns, viz., those requiring the attention of an experienced engineer on the spot.]

The Steam Loop.

The device which has recently been put on the market under the above name and which is shown in diagram in the accompanying illustration combines great practical value with extreme simplicity. It is so simple, indeed, that it is remarkable no one has thought of it before. That its invention or, perhaps, more properly, discovery, was due to a mechanic instead of a trained engineer is a striking proof of how dull even the best educated are after all, in the application of knowledge to practical work.

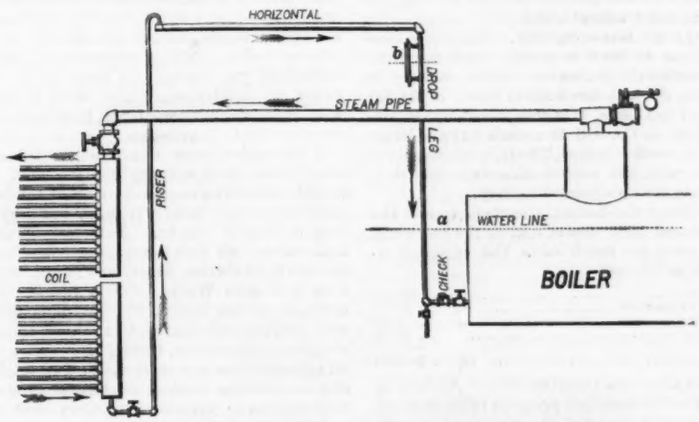
The office of the steam loop is to cause condensed water from steam radiating pipes or from an engine to flow back to the boiler when the latter is at a higher level than the former, and it performs this seemingly impossible feat without the aid of any

moving parts or the opening and closing of any valves.

It is a fact well known to steam-heating engineers that when steam is flowing through a pipe it carries along with it the water of condensation, generally in the shape of a thin film on the surface of the pipe, or, when a greater amount is present, in the form of short slugs or pistons, which are pushed along by the flowing steam. The working of the steam loop is dependent upon this fact, and also upon the fact that in any closed system of pipes filled with steam the lowest pressure is found at dead ends toward which, therefore, a continual flow of steam is maintained.

The accompanying diagram shows the arragement of a steam loop for returning the condensed water from the radiating coils of a steam-heating system back to the boiler. Its essential parts are the "riser" or vertical pipe from the lowest point on the radiating system, the "drop leg" or vertical pipe, with its lower end opening into the boiler, and the "horizontal," connecting the riser and drop-leg, as shown. The drop-leg is generally made of a larger size pipe than the riser and horizontal.

Suppose, now, the valve to be opened, admitting the steam from the boiler to the radiators. The boiler, radiators and steam loop form then a closed system of pipes in which the steam can freely flow toward the point of lowest pressure. The check valve at the bottom of the drop-leg prevents any flow into the drop-leg from the boiler. The steam from the boiler fills the coil, is partially condensed, and flows along, carrying with it the condensation, through the coils, up the riser and over to the drop-leg, where the condensed water slowly collects, filling the drop-leg soon to a point above the level of the water in the boiler. This flow of steam is caused, of course, by the difference of pressure on different parts of the system, due to the friction, condensation, etc. The pressure is lowest at the drop-leg, that being the point furthest from the boiler. The column of water which collects in the drop-leg, however, exerts a hydrostatic pressure, which increases as the height of the column grows greater, until at some point, as *b*, it becomes sufficient to counteract the lessened steam pressure in the drop-leg, and the water flows into the boiler. The flow is then continuous; the condensed water being pushed up the riser by the flowing steam as fast as it collects at the lowest point of the radiating system, continually fills the drop-leg; and from the lower end of the drop-leg water flows into the boiler in amount sufficient to keep the standing column of water at such a height that its pressure will equal the loss in steam pressure in the drop-leg.



THE STEAM LOOP APPLIED TO A HEATING SYSTEM.

It will be seen, then, that the operation of the loop depends on the fact that the water stands in the drop-leg and exerts a hydrostatic pressure, while in the riser it is carried up by the flowing steam in the form of small slugs or pistons, and exerts no hydrostatic pressure.

The operation of the steam loop being clear, we may consider its practical application. It is plain that the steam loop is a perfect substitute for the steam trap or steam pump as a means of returning condensed water, and vastly more economical from every point of view. It is in fact so simple, efficient and inexpensive a device that it will pay to apply it to thousands of steam heating systems, steam jackets and engines, where now the condensed water is wasted.

It is a fact which cannot be too strongly impressed upon every steam user and every mechanical engineer working with steam, that dry steam and the immediate return of condensed water to the boiler are of great importance as regards fuel economy. The large percentage of water contained in the steam taken from an ordinary boiler is not generally realized. Steam separators have of late become common for attaching to an engine to insure dry steam; but if, as is often the case, the condensed water from them is wasted, the heat contained in it is a total loss. It must be a very small plant, using very inexpensive fuel, in which the economy secured by the use of a separator and steam loop will not pay their entire cost in a few years or often in a few months.

In the case of heating and drying pipes, too, the use of the steam loop makes every plant practically a gravity return system, whose economy and simplicity in operation over any other system are well known.

Patents for the steam loop have been secured for the United States and foreign countries. Messrs. Westinghouse, Church, Kerr & Co. control the United States patents; and since they put the invention on the market, about two months ago, over 200 of them have been put in operation.

The Effective Area of Screws.*

The following examples of measurements recently made of the performance of screws are regarded as valuable instances of the verification of the statement made in RANKINE'S "Shipbuilding," p. 89. "The effective area is the sectional area already mentioned of the stream of water laid hold of by the propeller, and is generally, if not always, greater than the actual area, in a ratio which, in good, ordinary examples, is 1.2 or thereabouts, and is sometimes as high as 1.4, a fact probably due to the stiffness of the water, which communicates motion laterally amongst its particles."

The first instance is the case of a tug-boat upon which two screws were tried. These two screws were especially adapted for verifying the above theory, their actual disk area being the same, but their effective area greatly different. In one of the screws the blades were bent backward and had a form that tended to throw the water together after it was acted upon, thus diminishing the effective area; the other was of the ordinary form, in which the centre lines of the blades are at right angles to the shaft, and in which the effective area is considerably greater than the actual.

In addition to these two tests, the results obtained by Professor DENTON in his trials of the ferry-boat *Bergen* will be made use of, as well as those of fair reliability obtained on the steamer *Homer Ramsdell*.

The ratio of the effective to the actual disk area of the screws was found to be as follows:

Tug-boat, with ordinary true-pitch screw		1.42
" " screw having blades projecting backward		.57
Ferry-boat *Bergen*, with ordinary true-pitch screw	(at speed of 12.09 stat. miles per hour	1.63
	(at speed of 13.4 stat. miles per hour	1.48
Steamer *Homer Ramsdell*, with ordinary true-pitch screw		1.30

* Condensed from a paper by Prof. D. S. JACOBUS, Hoboken, N. J., read at the Cincinnati Meeting of the American Society of Mechanical Engineers.

The extremely low ratio for the screw with the blades projecting backward is probably not altogether due to the action of the blades in throwing the water together, because the loss produced by shock is taken the same as for the ordinary screw, whereas it is probably greater, on account of the fact that the blades were much thicker than in the screw that it replaced. In addition to this the area of each of the blades was about 25 % smaller than in the other screw. All we can say in this case is, that a construction of screw which tends to diminish the effective area will increase the slip. In our present state of knowledge, we cannot predict exactly how much of the indicated horse power is effective at the wheel.

In estimating the thrust of the screw the effective horse power is taken as equal to the indicated divided by 1.63, which figure was shown by Professor RANKINE to be correct for the ordinary class of screw steamers. Although in some recent experiments this figure is found to be nearer 2 than 1.63, those made on a late date on American ships have given figures about the same as that given by Professor RANKINE.

The dimensions of the wheels and data from which the above results are derived are :

	Bergen.		Tug boat.		Homer Ramsdell.
			Ordinary screw.	Special screw.	
Diameter of wheel in feet	8		8.5	8.5	11.1
Pitch of wheel in feet	8.9		12.0	14.0	15.8
Velocity of the boat through the water in statute miles per hour	12.09	13.40	11.77	11.32	16.02
Velocity of slip in statute miles per hour	2.18	2.88	1.73	4.5	2.00
Total indicated horse power	435.4	684.7	342.6	329.5	1,062.7
Estimated effective horse-power	267.1	420.1	210.2	202.1	652.0

The particular figures employed in the case of the ferry-boat *Bergen* are those for a single screw astern, and are an average of four tests, made from 11:45 A. M. to 1:15 P. M., Sept. 28, 1889, and of two tests made later on the same day."

American Names for Electrical Units.

At the regular monthly meeting of the American Institute of Electrical Engineers, held June 17, 1890, the following resolutions, recommended by the council, were introduced by Mr. FRANCIS B. CROCKER, with the request that they be taken up for action at the next meeting of the institute in September:

WHEREAS, It has been the custom in the nomenclature of electrical units to perpetuate the names of men who have contributed most to electrical science, and

WHEREAS, In the names thus far adopted the eminent services of Americans have not been recognized, therefore

Resolved, That in the opinion of the American Institute of Electrical Engineers a just distribution of the honors thus bestowed necessitates a recognition of the splendid contributions to electrical science of one or both of America's great electricians—BENJAMIN FRANKLIN and JOSEPH HENRY; and,

Resolved, That this Institute will gladly co-operate with other bodies in this country and abroad to secure the general adoption of these names for electrical units; and,

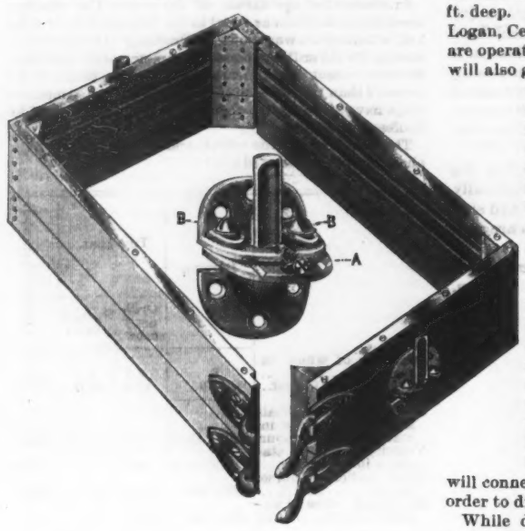
Resolved, That the name of Henry should be given to the practical unit of self-induction, since he was the discoverer and greatest investigator of this phenomenon, and because this unit at present time is called quadrant, which is merely a numerical value, and not a suitable name.

Resolved, That this Institute recommend to electrical societies and electrical engineers the general use of the name Henry for the unit of induction as being the quickest and surest way to secure its final adoption.

It is unfortunate that the name of HENRY for the unit of induction was not adopted at the Paris Electric Congress of 1889. If the attention of the Congress had been forcibly called to the fact that HENRY discovered self-induction and that his work on both self and mutual induction was of the greatest importance, his name would probably have been adopted then. HENRY'S discovery of self-induction, which is, of course, the fact that gives the strongest claim, was made in 1832 and published the same year in *Silliman's Journal*. In that paper he described experiments showing that the spark obtained by breaking a circuit composed of battery and a long wire is greater than with a short wire, and that the spark is further increased by coiling the wire. He then clearly states that the phenomenon is due to the *action of the current on itself*, all of which is perfectly correct, and would be a good statement of the facts even at the present time.

A New Snap Flask.

The molder's snap flask herewith illustrated is being placed on the market by E. C. Stearns & Co. of Syracuse, N. Y., who claim that the price at which it is sold ($2.50) is less than foundrymen can make them for themselves. The special advantages claimed for the flask are that the large V-shaped pins with corresponding bearings insure a level lift of the cope, enabling less experienced help to mould difficult patterns. In the central illustration is an enlarged view of the pins and guides at each end of



A New Snap Flask.

the flask. The brass screw *A* is used to take up any looseness or wear in the pins and the clasping screw *B* holds the parts together. The flasks are made of whitewood and the edges are bound with iron. The firm keep in stock 28 different sizes, embracing all widths from 9 to 12 ins., and all lengths from 13 to 19 ins. The metal furnishings are sold separately to those who prefer to make their own flasks.

An Immense Mine Tunnel.

On July 1, 1890, the workmen employed on the North and South ends of the Locust Mountain Tunnel cut through the intervening rock, and the largest inside tunnel ever driven in Eastern Pennsylvania was virtually completed. The history of the enterprise was as follows: The Locust Mountain Coal & Iron Co. and Lewis A. Riley & Co. decided in January, 1889, to unite and have an immense tunnel driven through the mountain for the purpose of draining the Centralia coal basin, and in this manner avoid the enormous expense of pumping out the water. They awarded the contract to Messrs. R. J. Malone & Co., tunnel contractors from New York, who broke their first ground on the north or Centralia end of the tunnel on April 15, 1889. Seven days later they also commenced work at the south or Big Mine Run end of the tunnel.

Mr. A. C. DOUGLAS, a member of the firm who has been in charge of the work, used three Ingersoll-Sergeant rock drills in each heading. The Ingersoll compressor plant was also used. The greater portion of the tunnel had to be driven through rock of a hard, fine, conglomerate nature. L. A. Riley & Co. had driven 171.9 ft. of the tunnel, to have it ready for the contractors, which left 4,993.3 ft. for the latter to drive. In all this distance they struck no vein of coal thicker than 3 ft., and the three leaders that were discovered were of an inferior quality. Many old and experienced miners had claimed that the Lykens Valley vein would be cut, but no trace of it appeared.

The north end of the tunnel was commenced in the Buck Mountain gangway of the old Hazel Dell colliery, and the progress was very slow for a while, owing to the heavy water which they had to contend with. During September and October the men were compelled to stand in water three feet deep while working, and Mr. DOUGLAS was compelled to secure larger pumps. In the South end, which was started at the base of the mountain about 50 ft. from the Big Mine Run breaker, they did not strike water until June. During the month of June the water was very heavy in both ends and the men worked in it waist deep.

The entire distance driven is 5,165.2 ft., or almost one mile, and the tunnel is 7 ft. high and 11 ft. wide, with a ditch for carrying the water 4 ft. wide by 2 ft. deep. It will drain the inside workings of the Logan, Centralia and Hazel Dell collieries, which are operated by L. A. Riley & Co., of Centralia, and will also give the operators access to the Mammoth vein workings, which have been filled with water since the burning of the Prevost breaker in 1879. The Girard estate may also decide to drain their Continental colliery, operated by the Lehigh Valley Coal Co., and the North Ashland colliery, operated by the Philadelphia & Reading Coal & Iron Co. through this tunnel.

Negotiations are now pending by which it is probable that R. J. Malone & Co. will be awarded the contract for driving still another tunnel which will connect with the one just completed. This will extend from the Buck Mountain vein to the Mammoth vein, a distance of 700 ft., in order to tap the immense body of water in the latter workings. It is also probable that Malone & Co. will be awarded the contract for another tunnel, 1,700 ft. in length, which will connect with the Locust Mountain tunnel in order to drain the Continental colliery.

While driving the Locust Mountain tunnel the plant consumed 1,785 tons of coal on the south end and 1,600 tons on the north end. The expenses incurred were as follows:

Plant and repairs	$34,558
Powder and explosives	30,182
Oil, lights, etc	2,761
Labor	59,721
Total	$127,223

The details above are from the *Miners' Journal*, of Pottsville, Pa. The monthly progress table does not exactly check with the total distance, but so nearly so as to make the record sufficiently reliable.

The number of feet driven in each end of the tunnel during the fourteen months required to complete the work is given in the following table:

1889.	South end.	North end.
April	60	61.23
May	281	186.5
June	216.78	184.7
July	193.8	127.9
August	169.6	238.9
September	160.3	111
October	168	207
November	148.1	168.6
December	193 8	117.7
1890.		
January	212.2	163.4
February	159.2	153.
March	161.5	146.6
April	201	177
May	169	148
June	175	154

Tests of Several Types of Engines Under Conditions Found in Actual Practice.

At the Cincinnati meeting of the American Society of Mechanical Engineers, Prof. R. C. Carpenter, of the Michigan State Agricultural College, read a paper with the above title, giving an account of tests recently made by him on several engines of different types under the conditions existing in actual daily service. The results of these tests are interesting as showing what may fairly be expected of engines of the different types tested in regular daily work. The engines tested were: (1) simple automatic engine, 14 × 20 ins., built by the Lansing Iron & Engine Works, taking steam from an ordinary tubular boiler. Engine worked at a disadvantage, as the load was too light for its capacity. (2) Compound non-condensing engine, built by same firm, with automatic governor for H. P. cylinder and fixed eccentric for L. P. cylinder.

(3) Reynolds-Corliss condensing engine in use about three years, running flouring mill. (4) Compound condensing engine, horizontal tandem type, running electric light dynamos, built by Lansing Iron & Engine Works. Automatic governor to both valves. (5) Two tandem compound engines in electric light station, nearly new; built by Lansing Iron & Engine Works. Steam furnished by two ordinary tubular boilers. (6) Two compound engines with independent condenser, running dynamos for electric street railway, throttling governor and cut-off adjustable by link motion. (7) Two triple-expansion condensing engines, horizontal tandem type, with automatic governors. Boilers used crude oil as fuel.

The results of the tests are given in the following table:

TYPE OF ENGINE TESTED.	Simple automatic.	Corliss condensing.	Compound non-condensing.	COMPOUND CONDENSING. Throttling governor, independent condenser.		Automatic governor belted condenser pump.			Triple expansion.	
Location	Jonesville, Mich.	Lansing, Mich.	Lansing, Mich.	Adrian, Mich.		Albion, Mich.	Lansing, Mich.		Jackson, Mich.	
Dimensions—High.	14 × 20	14 × 36	14 × 20 / 21 × 20	14 × 20 / 21 × 20		9¼ × 20 / 21 × 20	14 × 20 / 21 × 20		9¼ × 20 / 14 × 20 / 21 × 20	
Number of engines	1	1	1	2		1	2		2	
Steam pressure	70.3	69.	80.	83.7		130.5	100.1		98.0	
			1st Test. 2d Test.							
Steam per I. H. P.	30.3	26.87	32.8 32.6	27.53		18.77	16 57		17.98	
Per cent. entrained water	.....	0.67	.05 .05	.071		5.6	.11		.034	
									Oil.	
Coal per I. H. P.	5.34	4.63	5.3 5.12	4.52		3.05	1.96		.303 gal.	
Combustible per I. H. P.	4.76	3.61	4.2 4.12	3 24		1.97	1.69			
Evaporation per lb. coal	6.70	8.60	7.4 7.46	6.78		6 90	9.06			
Evaporation per lb. combustible	7.49	8.27	9.2 9.56	9.50		10.66	10.45		11.15	
				No. Eng.	So. Eng.		East Eng.	West Eng.	No. Eng.	So. Eng.
Vacuum in inches by gauge	.....	27	.....	27.2		26.4	23.0	23.1	21.0	24.0
I. H. P. High				50.58	45.83	56.04	68.28	43.30	55.2	49.0
I. H. P. Low									42.9	44.1
				30.74	31.80	34.43	69.04	47.50	46.8	22.4
							137.82	90.8	140.9	125.5
I. H. P., total	45.45	61.99	69.9 68.75	81.32	77.62	95.47	267.4		266.4	
Revolutions	171.5	95	149.8	184.1	193	160.5	172	172	165.7	165.6
Kind of work	Flour mill.	Flour mill.	Wheel fact	Electric light engines.						
MEASUREMENTS FROM INDICATOR CARDS.										
Steam per I. H. P.	24.5	22.	25.8	221	221.3	15.84	15.8	19.4	15.9	15.82
High pressure cards. Admission	63.3	53.	6.8	45.8	43.3	113.3	84	70	94	94.2
High pressure cards. Release	8.2	46.	20.	9.6	8.5	30.0	22	19	53.6	45.5
High pressure cards. Back-pressure	1.0	11.	15.	3.0	3.7	11.0	14	12.5	33.0	31.2
									39 8	31.6
Low pressure cards. Admission			15.	1.0	¾	7.3	10.1	6.0	12.3	6.6
									5.4	0.4
Low pressure cards. Release			4.	—6.0	—5	—5.45	—3.7	—5.0	5.75	0.4
									—2.84	—5.16
Low pressure cards. Back-pressure			2.5	—3.0	—3.5	—3.00	—7.5	—3.0	—5 6	—8.10
Ratio of cylinders									1 to 2 25	
Total expansions	5	15.	1 to 2¼ 22.5	1 to 2¼ 13.5	18.0	1 to 4.88 36	1 to 2.75 36.1 to 56		2.25 to 4.88 20.5	31.3
Fuel—kind	Jackson Hill Lump.	Soft nut.	Soft lump.	Jackson Hill Slack.		Soft Slack.	Soft lump and coke		Crude oil.	
Per cent. waste	.11	.22	.20	.286		.358	.133			

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO—Existing Roads.

Philadelphia & Reading.—A correspondent writes as follows:

The Harrisburg Terminal R. R. is to run from a connection with the Lebanon Valley R. R., in Harrisburg, Pa., to Bowmansdale, Pa., a distance of 8.76 miles. The surveys have all been completed and the contracts awarded. About 300 men are now at work on the line, and 3 miles of the grading have been nearly completed. The contractors are: Grading, Nolan & Bros., Reading, Pa.; masonry, Jamison & Monroe, of Bloomsburg, Pa.; and iron-work, Cofrode & Saylor, of Philadelphia. It is expected to commence tracklaying about Sept. 1, and to have the road completed by Jan. 1, 1891. The work from the Lebanon Valley R. R. connection to the west bank of the Susquehanna River consists principally of bridging, and from the latter point to the connection with the Harrisburg & Potomac R. R. at Bowmansdale of light grading through a rolling country. The maximum grade is 52.8 ft. per mile for a distance of 1.3 miles, and the maximum curve is 7°. The bridge crossing the Susquehanna River consists of 23 deck spans of about 150 ft. each, the top of the rail ranging in height from 60 ft. to 82 ft. from the bed of the river. E. Chamberlain, of 1,132 North Sixth street, Reading, Pa., is the engineer in charge of work.

Delaware River & Lancaster.—H. R. M. Whitman, of Kimberton, Pa., Chief Engineer, writes as follows:

Tracklaying has been completed from St. Peters to Sheeder, Pa., 8 miles, and construction is in progress on the remaining distance to Kimberton, Pa. About 50 men are now at work and it is expected to have the line completed and opened for traffic from St. Peters to Kimberton, by Oct. 1. The road is also projected to run from Springfield to Lancaster, Pa., 48 miles. The principal business will be in granite, lime and limestone, and general farm produce.

Delaware & Hudson Canal Co.—The contract is reported let for a railway from Addison Junction to Ticonderoga village, N. Y., a distance of 10½ miles, with a branch 1½ miles long to the Ticonderoga Pulp & Paper Mills. The cost of the road will be about $60,000.

Wabash.—A press dispatch from Chicago says: The Wabash road has added a valuable terminal to its system by the practical absorption of the uncompleted St. Joseph & Southern R. R. The Wabash guarantees $1,000,000 of the bonds of the St. Joseph & Southern, and by a connection at Sibley secures entrance into St. Joseph. The line will be ready for the rolling stock this year.

Baltimore & Ohio.—It is reported that this company intends to construct a branch from its main line near Pittsburgh, Pa., to Punxsutawney, Pa., to connect with the Buffalo, Rochester & Pittsburg R. R.

Parry Sound Colonization.—At a recent meeting the following directors were elected: Wm. Beatty, P. McCurry, President; John McClelland, F. S. Walton, J. M. Ansley, David Beatty, Samuel Armstrong; Jos. W. Fitzgerald and Geo. N. Gladman. Work has been commenced at Emsdale, Ont.

West Shore.—The preliminary surveys have just been completed for a line from Newburg to Walden, N. Y., where connection will be made with the Wallkill Valley R. R. The road is about 16 miles long, and runs through a difficult country.

Philadelphia & Reading.—It seems probable that this company will soon begin work on a branch through Atlantic County, N. J. The route is to be from Elwood via May's Landing, to Somers Point, and will pass through a good section of the country. Its cost would be considerable, there being a large amount of trestle work.

Findlay & Western.—A press dispatch says:

Two hundred men and teams began work this morning on the extension of the Findlay & Western road between Findlay, O., and Fort Wayne, Ind. This company, which was incorporated at Columbus a few days ago, is composed of the parties who bought the American Midland at the recent sale by the United States District Court. It is their intention to build the road to the Indiana State line as soon as possible. Another company will be at once incorporated at Fort Wayne to build the road to the Ohio State line, where it will connect with the Findlay & Western.

Montreal & Western.—The work of construction on the first section of this railway is progressing favorably. The earth work between St. Jerome, P. Q., and Shaw bridge is completed, and the laying of the rails is now in progress. Seven hundred tons of rails, sufficient to complete the first 10 miles, are expected to arrive from Barrow-on-Furness in a few days, and it is hoped to have trains running in a very few weeks. Over 100 men are now employed on the work.

Projects and Surveys.

Bristol.—Geo. A. Ayer, of Bristol, Vt., Vice-President and Superintendent, writes as follows:

This road is projected to run from New Haven, Vt., via Bristol, Monkton, Hinesburg and Huntington, to Richmond, Vt., a distance of 25 miles, but only the section from New Haven to Bristol, seven miles, will be built at present. A. M. Gallup, of Bristol, has the contract for grading this section. It is expected that tracklaying will begin about Sept. 30, and the line completed by Nov. 30. The work is generally light; maximum grade 150 ft. per mile, and maximum curve 8°. The principal business of the road will be in timber, agricultural products, iron and marble. About ⅗ of the right of way for the section under construction has been obtained, and considerable local aid from the people along the route secured. The company is ready to purchase seven miles of 56-lb steel rails, second-hand, 1 second-hand locomotive, second-hand passenger and baggage cars, and 10 second-hand freight cars, and will receive bids for building 14 miles of fence and furnishing 20,000 cross-ties. Josh. J. Rielley is President, and J. M. Fitch is Chief Engineer. The principal offices are at Bristol, Vt.

Zig Zag.—Wm. M. Sargent, of 34 Exchange St,, Portland, Me., General Counsel, writes as follows:

This road is at present projected to run across Peak's Island from the ocean to the harbor, a distance of about 1½ miles, with possible extensions in the future. The surveys will be completed by Aug. 10. The work is generally easy, there being only a small amount of rock work and pile driving. The principal business will be the local passenger and freight traffic to the various summer resort hotels. All of the right of way has been secured. Proposals are invited for the construction of the road. The company was chartered July 21 1890. Julius Akeroyd, of Boston, Mass., is President, and E. C. Jordan, of Portland, is Chief Engineer.

Kinzua Hemlock.—Chartered in Pennsylvania to build a line of railway 14 miles long. President, Thos. S. Kane, of Kane, Pa.

South Pennsylvania.—The presence of a corps of engineers at work in Bradford Co., Pa., has given rise to the report that this road is to be built at once.

South Lyon & Northern.—Chartered in Michigan to build a railway from Lelands, seven miles north of Ann Arbor, through Oakland, Livingston and Genesee counties, to Flint, Mich.

Skowhegan & Norridgewock.—Surveys are reported in progress on this Maine railway. Frederic Danforth, of Gardiner, Me., is Chief Engineer.

SOUTHERN.—Existing Roads.

Nashville, Chattanooga & St. Louis.—Hunter McDonald, of Huntsville, Ala., engineer in charge of the Tennessee & Coosa extension, writes as follows:

Bids for the grading, trestle-work and tracklaying of sections 11 to 33, inclusive, were opened on July 25. The amounts of the bids were as follows: O'Hearn Bros., $154,603; Dunn Bros., $168,086; Richmond & Hix, $190,610; Allison, Shafer & Co., $147,860; Serpelle & Morris, $156 218; W. E. Dorwin, $165,317; Elliott & De Bardleben, $196,402. The contract was awarded to Allison, Shafer & Co.

Talladega & Coosa Valley.—D. M. Rogers, of Talladega, Ala., writes as follows:

The charter was granted in Jan., 1890, for the Cook Extension, which is projected to run from Renfroe to Cook, Ala., a distance of 8 miles. The route is through an undeveloped mineral section, and the principal business of the road will be in minerals and lumber. The work is generally light; maximum grade, 1½%, and maximum curve, 8°. About 100 men and 60 teams are now at work on the road, and 2 miles of the track have been laid and 4 miles of the grading finished. It is expected that the road will be opened for traffic by Oct. 1. M. A. Arnold, of Talladega, Ala., is the engineer in charge of work.

Louisville, New Orleans & Texas.—The branch from Clarksdale to Minter City, Miss., will, it is expected, be completed by Aug. 1.

Middle & East Tennessee.—The contract for building this road from Hartsville to Dickson, Tenn., 15 miles, has been let to J. C. Radmore & Co. The road is to be completed by Jan. 1, 1891.

Cincinnati Southern.—A press dispatch says:

Work has been commenced on the Burnside & Cumberland River Ry. This road is being built to connect the Cincinnati Southern Ry. with the Cumberland River, and when completed will be operated in connection with a packet line on that river. Under the contract the road is to be completed and in operation this fall. A large force of men is already at work, and this force will be sufficiently increased to meet the requirements of the contract.

East Tennessee, Virginia & Georgia.—This company will, it is stated, survey a line from Mobile, Ala., to New Orleans, La., paralleling the Louisville & Nashville R. R.

Louisville & Nashville.—The grading has been completed and tracklaying is now in progress on the 6-mile extension of the Tuscaloosa branch of the Birmingham Mineral R. R.——The Anniston & Atlantic R. R. has been changed to standard gauge the entire length. The surveys are nearly completed and grading is well under way on the line from Sylacauga to Calera, Ala.

Alabama Midland.—An official is reported as speaking as follows in regard to the Montgomery, Tuscaloosa & Memphis R. R.:

The road has been graded and the trestles erected over the entire distance between Montgomery and the Alabama River, a distance of about seven miles. On that part of the road we are now ready for the rails and crossties. We have the steel and timber on hand and will begin the work of putting down the track in a few days. The crossings on the Louisville & Nashville and the Western lines are both arranged for, and we will have no further trouble on that score. Our purpose is to lay the track between the city and the river as soon as possible, so as to be able to lay the material down for building the bridge. We are now at work on the foundation of the bridge, but the work cannot progress far until we can run trains out and put the material down. The line of the road between Tuscaloosa and Maplesville is now covered with grading forces. We hope to commence laying track on the line between Maplesville and the river about Aug. 1, and the indications are that trains will be running through by the first of next year.

Wilmington, Onslow & East Carolina.—Tracklaying has been completed from Wilmington to Sandy Run, N. C., a distance of 23 miles.

Mobile & Girard.—Work is reported in progress on the proposed extension from Troy to Andalusia, Ala.

Projects and Surveys.

St. Johns & Santa Fe.—A project is on foot to build a railway from Jacksonville, Fla., to Fort White, Fla., a distance of 75 miles. J. A. Bryan, 10 Hubbard Block, Jacksonville, is interested.

Peace River & Boca Grande.—Chartered in Florida to build a railway from the headwaters of Peace River to Boca Grande, Fla. Among the incorporators are: M. T. Singleton and J. L. Sandlin.

NORTHWEST.—Existing Roads.

Pawnee.—The immediate extension of this Illinois road to Auburn has, it is stated, been decided upon.

Projects and Surveys.

Sioux City & Northwestern.—This company proposes to construct a railway from Sioux City, Ia., through the Sioux Indian reservation to the Black Hills. Among the incorporators are: A. S. Garretson, D. T. Hedges, S. L. Dows, T. P. Gere, and J. F. Duncombe.

Chicago, Springfield & St. Louis.—Chartered in Illinois to build a railway from Springfield to Chicago, Ill. Among the incorporators are: Walter L. Pratt, Wm. Black, Geo. W. Lewis, Wm. F. Daley, all of Chicago.

Addison.—Incorporated in Illinois to build a railway from South Addison to Addison, Ill. Among the incorporators are: John L. Backhaus and Wm. E. Loesenberg.

Quincy, Omaha & Kansas City.—A press dispatch says:

Amos Green, president of the Quincy, Omaha & Kansas City road, which is completed to Trenton, Mo., announces officially that his road will be built from Trenton to Stewartsville, where a connection will be made with the Chicago, Kansas City & Texas. Trains on the new road will enter Kansas City over the Winner Bridge, which is now nearing completion.

SOUTHWEST—Existing Roads.

Chicago, St. Paul & Kansas City.—H. Fernstrom, of St. Paul, Minn., Chief Engineer, writes as follows:

The Leavenworth & St. Joseph Ry. is projected to run from a point on the St. Joseph & St. Louis R. R., near St. Joseph, to a point on the Chicago, Rock Island & Pacific R. R., near Leavenworth, Kan., a distance of 23 miles. The surveys have been completed and the contracts for construction let to McArthur Bros., of St. Paul, Minn., work to begin at once. There will be about 25,000 cu. yds. of earthwork per mile; maximum grade 1% and maximum curve 4°. It is expected to commence tracklaying about Sept. 10 and to have the road completed some time in December. The business of the line will be principally the through traffic with a small amount of local traffic. The work is in charge of the Chief Engineer.

Kansas City, Wyandotte & Northwestern.—It is announced that the Missouri Pacific Ry. Co. has secured control of this Kansas road.

Projects and Surveys.

Reed Springs & Kansas City.—Samuel Hardwicke, of Liberty, Mo., Vice-President, writes as follows:

It is expected that this road will be a part of the Chicago, Kansas City and Texas Ry., projected by Willard E. Winner, the junction to be at Rock Creek, three miles east of the Winner Bridge at Kansas City, Mo. No permanent arrangements have been made with this company, however, and if the negotiations should fail, an endeavor will be made to interest the Wabash Ry. Co. in the enterprise. This failing, the company has a charter for a bridge across the river, and will build as an independent enterprise. The length of the road will be 11 miles; maximum grade 1%, and maximum curve 3°. The principal business will be the local and suburban passenger traffic, and coal from the mines at Randolph and Birmingham. The surveys have been completed and nearly all of the right of way secured. No work will be done until the Winner Bridge is completed. The officers of the company are: President, G. T. Reed, Kansas City, Mo.; Vice-President, Samuel Hardwicke, Liberty, Mo.; Secretary, J. D. Swan, Reed Springs, Mo.; Treasurer, W. N. Ewing, Kansas City, Mo.; Chief Engineer, Gustave Dyer.

Hains, Hamilton & Kingston.—S. C. Rogers, of Kingston, Mo., writes as follows:

The survey has been completed for this road which is projected to run from Kingston to Hamilton, Mo., where it will connect with the Hannibal & St. Joseph R. R., a distance of 8 miles. The road will be standard gauge, with easy grades and curves. A portion of the right of way has been secured and about $30,000 have been subscribed by the towns of Kingston and Hamilton. The road will be built by Hains' Bros., of New York City, and work will begin at once. Charles D. Hains is President.

Kansas City, Louisiana & Gulf.—Jas. J. Waitz, of Atchison, Kan., Chief Engineer, writes as follows:

This road is projected to run from Kansas City, Mo., via Ft. Smith and Camden, Ark., Arcadia, Montgomery, Colfax and Boyce, La., to Vermilion Bay, La. The section from Arcadia to a point on the Red River, near Boyce, 87 miles, has been located, and it is expected that work will begin in September. The work is easy; maximum grade 1% and maximum curve 8°. There will be an 820-ft. bridge over the Red River. The right of way has been secured for this section and considerable other local aid obtained from the people along the route. The principal business will be in timber, cotton, sugar cane, rice, cattle, marl, iron ore, and general farm produce. The stockholders of the company will meet Aug. 13 to elect officers and directors.

Paris, Hearne, Brazos & Gulf.—Chartered in Texas to build a railway from Hearne to Brenham, 50 miles. Among the incorporators are: H. K. Davis, H. B. Allen, L. W. Carr, A. W. Bridge, and others of Hearne, Tex.

ROCKY MT. AND PACIFIC.—Existing Roads.

Seattle, Lake Shore & Eastern.—A correspondent writes:

Construction is well under way on the Northern branch of the S., L. S. & E. R. R., which is projected to run from a point 20 miles north of Snohomish, Wash., to the International boundary, a distance of 82¾ miles. The work is about average, the route being through a rolling country; maximum grade 1.5% and maximum curve 6°. There will be bridges across the Stillaguamish, Skagit and Nooksak Rivers. The principal business will be in timber, minerals and agricultural products. The contractors are: Earle & McLeod, P. J. Murphy, Smith Bros. and the San Francisco Bridge Co., address Seattle, Wash., and M. J. Henry and Clements, Bradford & Co., of Nooksak City, Wash. It is expected that the line will be completed by Nov. 1. R. H. Talcott is the engineer in charge of work.

Union Pacific.—Kilpatrick Bros. & Collins, of Beatrice, Neb., are reported to have the contract for building the line from Portland, Ore., to Seattle, Wash.

Denver & Rio Grande.—About one-fourth of the grading has been completed on the extension from Keldar to Red Cliff, Colo., 20 miles.

Ellensburg & Northeastern.—It is announced that Thomas L. Nixon has succeeded in placing the bonds of the Ellensburg & Northeastern R. R., on which it is intended to commence work immediately. The route of the road is eastward from Ellensburg to the Columbia River, thence in a northwesterly direction to the Conconully mines, a total distance of about 120 miles. The first 15 miles of the road are already graded, and it is thought the Columbia river can be reached this fall. The Ellensburg & Northeastern R. R. Co. began work last summer immediately after its organization, but stopped after grading several miles, as mentioned.

CITY TRANSIT.

Elevated Railway.—***Brooklyn, N. Y.***—The Kings County Elevated R. R. has under discussion the extension of its lines as a surface railway over a large portion of southwestern Long Island.

Dummy Railway.—***Louisville, Ky.***, will soon have a line managed by the street railway company.

Horse Railways.—***Nashua, N. H.***—Extensions will be made.

Middletown Conn.—A company has been granted a 10-year franchise.

New Companies.—The New Albany, Ind., Highland Railway Co.; capital stock, $50 000. The Aurora, Ill. Street Ry. Co.; capital stock, $50,000; incorporators, M. C. Orton, J. O. Curry, D. J. Hogan. The Oak Street Ry. Co., Kansas City, Mo.; capital stock, $50,000; incorporators, W. B. Morehead, J. A. Forbes, P. C. Phillips.

Electric Railways.—***Brooklyn, N. Y.***—The Coney Island & Brooklyn Ry. has received permission to use electricity on its lines. A new road will be built to Fort Hamilton.

Buffalo, N. Y.—The line to Niagara Falls is now assured, all objections having been withdrawn.

Kittanning, Pa.—A line will be built to Ford City, a distance of 7 miles. Address Dr. S. A. S. Jessop.

Shelby, N. C.—The Land, Loan and Improvement Co. may build a line.

Beaufort, S. C.—A route is said to be surveyed to Port Royal.

Terre Haute, Ind.—Electricity will replace horses.

Belleville, Ill.—Surveys for a line to East St. Louis are being made.

Knoxville, Tenn.—The Cherokee Land Co. expects to build an electric railway on its property.

Little Rock, Ark.—The Capital Street Ry. Co., operating 15 miles of track, will replace horses by electricity.

Milwaukee, Wis.—The line to Whitefish Bay has applied for right to use the overhead system.

Golden, Colo.—Surveys are in progress for a line to Denver.

Albuquerque, N. Mex.—A 15-mile line will be built by a Philadelphia, Pa., company.

Oakland, Cal.—An overhead line will be built by J. W. Coleman, C. W. McNear and others.

Possible Lines.—At Leeds, Ia., D. F. Hedges is interested; Braddock, Pa.

New Companies.—Pelham Bay Park Electric Light, Power & Storage Co., Pelham, N. Y.; capital, $10,000; incorporators, G. W. Cochran, C. S. Becker, B. Franklin. The Underground Electric Traction Co., Baltimore, Md.; capital stock, $100,000; incorporators, J. J. Husband, F. L. Morling, J. J. Meyer and others. The Owosso, Mich., Electric Ry. Co.; capital stock, $50,000; incorporators, H. L. Hollister, L. S. Hudson, M. D. Skinner. The Citizens Electric Ry. Co., Leavenworth, Kan.; capital stock, $300,000; directors, W. D. Kelley, J. W. Folger, L. Hawn and others. Metropolitan Electric Ry. Co., Seattle, Wash.; capital, $300,000; incorporators, J. Furth, B. Gatzert, A. P. Mitten and others.

HIGHWAYS.

New York.—About $40,000 will be spent for macadamizing at Flushing. A steam roller is wanted.

District of Columbia.—The Tenleytown road will be widened from 65 to 120 ft.

BRIDGES, TUNNELS AND CANALS.

Bridges. ***Marilla, N. Y.***—An iron bridge will be built over Cayuga Creek at this place.

Hunterdon Co., N. J.—About $10,000 will be expended in rebuilding bridges destroyed by the recent storm.

Delaware Station, Pa.—The Delaware, Lackawanna & Western R. R. has just commenced work on the new steel bridge across the Delaware River above Delaware Station. It is the intention of the company not only to replace the present iron structure, but to rebuild the piers also, making them heavier and stronger.

Saginaw, Mich.—Two iron bridges are to be built at this place.

Easley, S. C.—Elias Day will let contract on Aug. 7 for the rebuilding of the bridge over George's Creek.

Montgomery, Ala.—Proposals are wanted until Aug. 18 for the erection of a bridge over Catoma Creek, at this place. Address the Board of Revenue of Montgomery Co., Montgomery, Ala.

Montgomery, Ala.—C. A. Allen will receive bids until Aug. 18 for the construction of an iron or lattice bridge over Catons Creek.

Birmingham, Ala.—The bid of the Smith Bridge Co. for the 21st St. bridge at Birmingham, Ala., was $40,000 instead of $45,600 as stated last week.

Greenville, Miss.—C. M. Johnson will receive bids until August 4 for the construction of a pile bridge across Granicus Bayou.

Minneapolis, Minn.—The plans for the Washington Ave. bridge over the railway crossings have been completed, and bids will soon be advertised for. It will be 94 ft. long and 103 ft. wide.

New Iberia, La.—It is stated that an iron bridge will be constructed across the Teche River at this place.

Phœnix, Arizona.—A press dispatch states: D. M. Ferry, of Detroit, Mich., and C. C. Bowen, have made a proposition to build canals on the south side of Salt River, construct a new dam across the river, and consolidate the heads of all the canals on that side. The plan is to locate the dam above that of the Arizona Canal, which feeds all the canals on the north side, being a short distance below the Verde River. Here two points of red sandstone project into the river, where a dam 450 ft. long and 40 ft. high is to be built. The canal will be 50 ft. wide at the bottom, six ft. deep, and carry 500,000 miners' ins. of water. The rock cut will be 2 miles long, and 36 ft. deep at places. The undertaking will be one of the largest in the valley, and cost about $50,000. The canal will furnish great water power. There will be one drop of 14 ft. to the Highland Canal, one of about 20 ft. to the Mesa Canal, one of 15 ft. to the Utah Canal, and a fall of 30 ft. over which to carry the 9,000 ins. of the Tempe Canal.

WATER-WORKS.

NEW ENGLAND.

Manchester, N. H.—Superintendent Chas. K. Walker writes:

Surveys are being made for a high service system by M. M. Tidd, of Boston, Mass.

Middlebury, Vt.—Charles J. Starr has offered to subscribe $6,000 for constructing works.

Springfield, Mass.—The Water Commissioners have rejected all bids for the construction work for the new supply, except those of Wm. P. Latham, Florence, Mass., F. E. Shaw, Providence, R. I., and Geo. M. Atkins & Co., of Palmer, Mass., who bid separately on the three sections of the work, and to whom, it is thought, the contracts will be awarded next month.

Fall River, Mass.—Superintendent Patrick Kiernan has sent us the following:

An appropriation of $10,000 has been made for extending the water service, but no order has yet been issued specifying what the improvements will be.

Coventry, R. I.—The Warwick & Coventry Water Co has been granted the privilege of laying mains.

Providence, R. I.—The Common Council has passed a resolution appropriating $75,000 for the repairs to the Fruit Hill Reservoir. This was the estimate of the consulting engineers, Messrs Francis and Church.

Unionville, Conn.—Regarding the report that works were projected, Melvin J. Weeks has sent us the following:

There is nothing of the kind on foot at present. Public water-works may be constructed in a few years, but there is no immediate prospect of it.

MIDDLE.

Great Neck, L. I., N. Y.—Articles of incorporation of the Great Neck Water Association, of North Hempstead, have been filed with the Secretary of State by August Rocsles, Charles C. Gignoux, Edward Winslow, William R. Grace and Richard Field. Capital stock, $2,000. The company will supply water for domestic, manufacturing, municipal and agricultural purposes.

East Aurora, N. Y.—The water supply will be taken from springs recently purchased.

Babylon, L. I., N. Y.—Dr. Arnold, J. J. Robbins and J. R. Reid have been appointed a committee to investigate the question of water supply. The Lockwood Water Co. offers to supply water for $750 per year, and the Long Island Water Supply Co. at $900. The question of the town building and maintaining its own works is also to be considered.

Brooklyn, N. Y.—Changes are to be made to the storage reservoir on the St. Johnland Farm, as follows:

Changing the slopes to a slope of 2 to 1; paving the sides and the dam; raising the inlet chamber to the established grade; constructing a 3,000 ft. parapet. This work will require 10,000 cu. yds. of excavation, 17,500 yds. of reshaping, 17,000 sq. yds. of stone repaving, 1,500 cu.y ds. of rubble masonry, 6,000 cu. yds. of concrete, 5,000 cu. yds. of gravel, 4,000 cu. yds. of puddle clay, 3,000 ft. of coping, and a wrought iron railing 6 ft. high to go around it. The estimated cost of these improvements is $225,000.

Glens Falls, N. Y.—On Sept. 1 bonds for $45,000 will be sold in instalments of $5,000 each.

Norristown, Pa.—Dr. Charles M. Cresson has examined the water supply, and found it impure and unfit for use. The use of public wells is to be entirely abandoned, and a new source of supply will probably be secured.

Pittsburg, Pa.—The Monongahela Water Co. is laying a 36-in. main on South Twenty-ninth St. and a 20-in. main in the 26th Ward. Mains are being laid by the Water Department to supply Glenwood and Haselwood with water.

Ocean City, Md.—Judge Holland has planned to secure an adequate supply of pure water by laying a line of terracotta pipe across the Synepuxent River from some point in Worcester east of Berlin.

SOUTHERN.

Wheeling, W. Va.—A scheme is projected to lay a main from springs in Fourteenth St. to the Public Building Square.

Statesville, N. C.—Bids are wanted for putting in 40 hydrants and laying 5 miles of 12 to 4-in. mains, by D. A. Miller, Mayor.

Asheville, N. C.—Regarding statements that a storage system was to be constructed, F. M. Miller, City Clerk, writes:

There is need of more storage room for water, but no official action whatever has been taken toward securing it.

Darlington, S. C.—We have received the following information from Henry F. Thompson;

The Darlington Water Co. has been awarded the contract for putting in works and construction has been commenced. They will probably be completed in September. Acting President, C. S. McCullough. Water will be pumped to a tank. Population, 3,000.

Albany, Ga.—The Artesian Well Drilling Co., St. Augustine, Fla., has been awarded the contract for drilling a 12-in. well by Nelson Tift.

Macon, Ga.—It is reported that Superintendent J. W. Wilcox will want a pulsometer or pump with capacity for from 600 to 1,000 galls. per minute; also a small steam hoist.

Tallapoosa, Ga.—Surveys for works are being made. They will be put in by a New York syndicate. Estimated cost, $50,000. Pipe has been purchased. A stand-pipe will be used.

Tampa, Fla.—First mortgage 25 year bonds are being offered for sale.

De Land, Fla.—Work will soon be commenced.

Opelika, Ala.—B. T. Phillips has sent us the following:

A private corporation proposes to construct works to cost $60,000. Address F. M. Renfro, Recorder. Population, 4,000.

Okolona, Miss.—The following is from James Williams, Town Clerk:

There are no works in this place at present. The town wishes to enter into correspondence with a firm to sink an artesian well.

Alexandria, La.—A syndicate of capitalists have asked for the right to construct works. They propose to bring water from Castor Creek, about 8 miles southwest of the town. The cost of the system is estimated at $125,000.

Johnson City, Tenn.—The 3,000,000-gall. reservoir is to be lined with cement. The water supply is brought from Buffalo Mountain, 2 miles distant.

Hill City, Tenn.—W. S. Kuhn, General Manager of the American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa., has sent us the following:

We do not contemplate running a pipe line to Hill City at present, but may at some future time. Beside completing the plant on Lookout Mountain we do not expect to make any very extensive improvements in the near future on that plant, although it is possible that a plant may be erected by us on Mission Ridge, requiring 3 miles of pipe, a stand-pipe and a 1,000,000-gall. pump; but the matter has not progressed far enough to give details.

Lexington, Ky.—A chemical analysis has been made of the water furnished the city by the Hydraulic and Mfg. Co., and it is found to be very impure.

Fulton, Ky.—The following information is from Ed. Starks, Chairman Water Board:

Contracts will be let by the city about August 15 or 20. Work is to be commenced on Sept. 15 and completed by Jan. 1, 1891. Water is to be pumped from wells to a stand-pipe. Estimated cost, $21,000. Population, 3,000.

NORTH CENTRAL.

Zanesville, O.—The following bids have been received for furnishing supplies:

Pipe: Addyston Pipe and Steel Co., Cincinnati, O., 5,600 ft. 30-in. 1,500 ft., 10-in., at $27 per ton. Special castings 2¾ cts. per lb., delivered. Dennis Long & Co., Louisville, Ky., $27.25 per ton. Special castings 3 cts. per lb. Valves: Galvin Brass and Iron Works, Detroit, Mich., represented by F. O. O'Brien, Manager, 5, 30-in. Class A, $1,375; class B, $1,450; class C, $1,475; class D, $1,550. Eddy Valve Co., Waterford, N. Y., represented by H. C. Rogers, Vice-Prest., 30-in. class 4, $350 each; class 5, $250, total, $1,650. T. B. Townsend Co., Zanesville, O., 250 ft. tunnel, $4,340; Adams Bros., $4,600.

Marshfield, O.—The Gordon Steam Pump Co., of Hamilton, O., has been awarded the contract for furnishing a 4,000,000-gall. compound condensing horizontal pumping engine.

Cincinnati, O.—Superintendent Tharp has been instructed to at once prepare plans, specifications and estimates for an additional incline at the West End pumping station, on which are to be placed two 7,000,000-gall. pumps. Also for a circular well house, in which will be placed four 10,000,000 gall. vertical pumps.

East Liverpool, O.—A new 3,000,000-gall. compound condensing vertical engine will be furnished by the Gordon Steam Pump Co., Hamilton, O.

Cleveland, O.—The site for the proposed new crib has been selected.

Port Huron, Mich.—Col. William Ludlow has recommended that about six acres of Government land, above Fort Gratiot, be sold to the city for a nominal sum. The city wishes to secure it and proposes to remove the pumping station, etc., to this site as a means of increasing and improving the water supply.

Hudson, Mich.—The ordinance establishing a Board of Water Commissioners has been annulled. The City Council will oversee matters in the future, and push the construction of works to completion.

Coldwater, Mich.—The Common Council passed an ordinance on July 28 calling a special election on Monday,

Aug. 18, to decide the question of issuing $70,000 of 5% bonds, for putting in works. The people voted to issue the same amount at 4% last May, but the rate of interest was so low that the bonds found no takers.

Detroit, Mich.—Statistics of water consumption show a large saving from the use of meters. About 600 are now in use, and additions are constantly being made.

River Forest, Ill.—The proposition submitted to the last meeting of the Village Board from the proprietors of the Proviso water system meets with much favor, and there is little doubt but that a franchise will be granted to the company.

Venice, Ill.—Bids for laying a small amount of new mains will be received until Aug. 4.

Carrollton, Ill.—The City Council has let the contract for constructing a system of works to a Chicago firm at $19,463. The works will include a tower 116 ft. high, a 56,000-gall. reservoir, pumping station and nearly four miles of mains Work is to begin Aug. 1 and be completed by Nov. 15. The water supply will come from the artesian well recently completed.

NORTHWESTERN.

Eagle Grove, Ia.—The works are to be extended.

Rock Rapids, Ia.—The new works have been completed and satisfactorily tested.

Toledo, Ia.—A vote will be taken on Aug. 11 on the question of constructing works.

Hampton, Ia.—Charles Krag, City Recorder, requests us to state:

No action has yet been taken by the City Council in regard to the contemplated works, and until the question "where to get the water is settled," nothing will be done. When that question is determined and the city is ready to issue its bonds and let the contract, all letters received by him will be duly answered.

Sioux City, Ia.—Surveys for the new plant on the Big Sioux have been completed. The data required have been forwarded to the engineers, MacRitchie & Nichol, of Chicago, Ill., who are expected to soon complete the plans for the system.

Arnold, Neb.—The Town Council has ordered an ordinance drawn up to vote bonds for $7,000 to build another well, buy another boiler, and extend the water mains.

Benkleman, Neb.—Bonds for $3,500 will be issued for putting in a system of water supply. A small pumping engine, tank, 12 hydrants, etc., will be purchased.

Sutton, Neb.—Works are to be constructed. Address the Mayor.

Canton, S. Dak.—Works are to be constructed.

Pierre, S. Dak.—About one mile of new mains will be laid at once.

Huron, S. Dak.—The Huron Water-Works Co. has filed articles of incorporation.

Fargo, N. Dak.—The Fargo Water & Steam Co. has made a proposition to sell its entire plant to the city.

Cheyenne, Wyo.—The City Council has authorized its Water Committee to conduct experimental boring at the source of the water supply, with a view to locating an undercurrent in the river.

Butte City, Mont.—A certificate of incorporation of the Summit Valley Water Co. has been filed at Helena. The company is formed to supply and sell water to the people of Butte City and vicinity for domestic, manufacturing, milling, smelting, reduction and irrigating purposes. Capital stock, $500,000. The incorporators are William A. Clark, Henry L. Frank and Patrick Talent.

SOUTHWESTERN.

St. Louis, Mo.—Sealed proposals will be received until Aug. 8 by the Board of Public Improvements, Emory S. Foster, Secretary, for the following:

Hydrants, 175 underground hydrants, delivered; stop valves; about 36, 20 to 6-in.; coated water pipe, 1,500 tons of 20, 12, 8 and 6-in.; excavating and laying complete, 43,300 lin. ft. 6-in., 2,150 lin. ft. 8 in., 4,400 lin. ft. 20-in.; setting 100 fire plugs; furnishing 4,000 lbs. wrought-iron straps.

Mound City, Mo.—J. M. Hsness, City Clerk, has sent us the following information:

Contracts will be let on Aug. 15. Work will be commenced on Sept. 1 and completed as soon as possible. Bonds for $14,000 will be issued by the town. Water will be pumped from tubular wells to a stand-pipe. Mr. Kiersted is the engineer. Population, 1,500.

Brinkley, Ark.—The Cook Well Co., St. Louis, Mo., has been awarded the contract for sinking artesian wells for the company.

Dublin, Tex.—It is reported that Whitehead & Stancil have received a franchise to construct works. Also that an artesian well will be sunk at once.

Bastrop, Tex.—A stock company is to be formed to put in works. A. B. McLevy, J. W. Kennedy, R. L. Batts, P. O. Elsener and T. A. Hasler have been appointed a committee to decide upon the system to be adopted, and to secure data and estimates of cost, and to report as soon as possible.

Austin, Tex.—The City Council has passed an ordinance authorizing the immediate issue of $1,400,000 of 5% gold bonds for constructing a dam across the Colorado River and putting in water and electric light works.

Galveston, Tex.—A special committee has been appointed to look after the preliminary work of sinking the deep well, and bids will soon be wanted. J. M. Brown is one of the water commissioners.

Floresville, Tex.—The following is taken from the Houston *Post*:

Our men of enterprise and means are waiting for some man or men to provide us with water-works. There is money in it. A smart man with $10,000 could establish a system here and live independently off of the proceeds. The river is one mile distant.

Colorado Springs, Col.—The question of water supply is seriously engaging the attention of the citizens.

Aurora, Col.—(A suburb of Denver, Col.)—The East Denver Water Co. is laying a large main through the place, from which the Colfax Trust Co. is laying 6-in. mains to every house. The water supply is pumped from beneath the bed of Sand Creek and water almost perfectly pure is secured.

Silver City, N. M.—The city has annulled its contract with the Geo. H. Utter Water-Works Co.

PACIFIC.

Blaine, Wash.—We have received the following:

The works will be built by a private company. Estimated cost, $100,000. Hydrants will be used. The supply will probably be furnished by gravity from a creek. Address J. V. Chown or J. M. Wiestling, Seattle, Wash., for further information.

Shelton, Wash.—The City Council is considering the proposition to bond the city for the purpose of putting in a water system for domestic and fire purposes.

Seattle, Wash.—Contracts have been awarded as follows:

Pipe, cast-iron: Coit, Barton & Cowles Co., 1,213 tons 30-in.; 688 tons 20-in.; 100 tons 12-in; 75 tons 10-in.; 14 tons 8-in., at $44.94 per ton; the 6, 8, 10 and 12-in. pipe to be delivered at once; the remainder at the end of August. Spiral weld steel pipe, 12,000 ft. 12-in., at $1.40½; 6,000 ft. 8-in., at 74 cts.; 4,000 ft. 6-in., at 53¼ cts., to be delivered at once. R. D. Wood & Co., Philadelphia, Pa., were awarded the contract for the remainder of the pipe called for in the specifications at $110,033.82. Special castings: Coit, Barton & Cowles Co., at $3.51 per 100 lbs. Hydrants: 212 Galvin patent compound wedge hydrants, J. B. Clow & Co., at $5,049.90; 300 Galvin gate hydrants, $13,095. Valve boxes: J. B. Clow & Son, 300 at $2.25 each, and 225 Galvin valve boxes, at $3 each.

The question of purchasing a third pumping engine, 7,000,000 galls. capacity, is being considered.

Spokane Falls, Wash.—Steps are being taken to provide an efficient system of works. J. J. Browne is interested in the citizens' movement.

San Francisco, Cal.—The Spring Valley Water Co. has let a contract to A. E. Buckman for raising the dam at the Upper Crystal Springs Reservoir. The specifications call for the placing of from 40,000 to 50,000 cu. yds. of earth. The contract price is 28 cts. per yd.

Oakland, Cal.—The Contra Costa *Gazette* says:

The Oakland scheme for supplying that city and other points with water from the Blue Lakes in the Sierras is being put into shape to test its practicability. A measure of this kind is likely to come within striking distance of Martinez.

Boise City, Idaho.—The Artesian Land and Water Co. has completed its stock subscription to nearly $40,000, and will at once order pipe sufficient to supply the entire city with pure mountain water.

Lewiston, Idaho.—Engineer Bloomfield, of the Lewiston Water Co., is reported as stating the following:

After investigation, it has been decided to take the supply from Clearwater River. The plant will consist of a brick engine and boiler house, 40 by 40 ft., on a concrete foundation, 14 ft. high, on the river front, into which will be built the wrought iron inlet pipe and pump well, with their attached screen, gate and foot valve. The pumping engine will be one of the modern type of double compound condensing engines, and have a daily capacity of 2,000,000 galls. The boiler will be of steel, 85 HP., with a steam pressure of 120 lbs. The reservoir will be cement lined and have a capacity of 1,500,000 galls. There will be about 9 miles of 12, 10, 8, 6 and 4 in. mains, with hydrants, valves, etc.

CANADA.

Cote St. Antoine, P. Q.—We have received the following from G. Daraford, Secretary and Treasurer, 196 St. James St., Montreal, P. Q:

The city has voted to issue $100,000 of bonds for putting in a complete system of works. Population, 2,000.

Montreal, P. Q.—The question of purer water is being considered, and it is probable that a new source of supply will be adopted.

Brantford, Ont.—Mains are to be laid and hydrants set to afford fire protection to the Ontario Institute of the Blind.

Windsor, Ont.—A new source of supply is proposed.

North Toronto, Ont.—J. Venables has submitted plans of the propcsed water supply scheme, according to which it is contemplated to bring the water from Fox's Creek, about ¾ of a mile distant, and construct a reservoir. The cost will be about $50,000, or with the reservoir and appliances about $68,740.

ARTESIAN WELLS.

Anderson, S. C.—The Anderson Ice Co. will put down a well and wishes to correspond with manufacturers of outfits.

Barnesville, Ga.—It is proposed to sink a well.

Iroquois, So. Dak.—Work on the well has been resumed.

Paradise, Tex.—A well is being sunk.

Vicksburg, Tex.—The Cook Well Co., of St. Louis, Mo. will deepen the 1,630 ft. well of the ice company.

IRRIGATION.

Laredo, Tex.—The Laredo Improvement Co. has issued $500,000 of bonds to improve its property by constructing an irrigating plant, etc.

Minidoka, Idaho.—Surveys are being made by U. S. engineers in this vicinity. They are locating irrigating canal as recently ordered and appropriated for by the Government.

Linuba, Cal.—Sealed proposal will be received until Aug. 16, for $65,000 of 6% Alta Irrigation District bonds. President, E. E. Gliddings; Secretary, George H. Weaver.

SEWERAGE AND MUNICIPAL.

Paving has been ordered at Troy, Brooklyn and New York, N. Y.; Pittsburgh, Pa., asphalt and Medina sandstone; Kansas City, Mo., stone; St. Paul and Duluth, Minn., Shelton, Wash.; Los Angeles, Cal.

Providence, R. I.—The improvement of a number of streets, at an estimated cost of $250,000 for land and labor, is under discussion.

Rochester, N. Y.—Assessment rolls for macadam, estimated at $21,500, and asphalt, estimated at $36,000, have been prepared.

Lockland, O., has prepared plans for grading and macadamizing costing $16,400.

Columbus, O.—Asphalt, Hayden or Hallwood blocks and brick on 6 ins. of gravel have been ordered.

West Duluth, Minn.—Thirty-two thousand dollars of grading is planned.

Sewers—*Bridgetown, N. S.*—A complete system is proposed.

Troy, N. Y.—A 26 × 40-in. brick sewer has been ordered.

Buffalo, N. Y., has prepared assessment rolls for brick and pipe sewers costing $52,678.

Rochester, N. Y., has ordered 12 and 15-in. pipe sewers at an estimated cost of $11,200.

Sheepshead Bay, N. Y.—A sewerage system costing $148,000 will be built.

Richmond, Va., will issue $75,000 of sewer bonds.

Louisville, Ky.—Plans for a large iron outfall sewer into the Ohio River have been completed.

Ridgeland, Ill.—City Engineer Alvord has prepared plans for a brick sewer costing $200,000.

Columbus, O., has ordered 2, 3 and 4-ft. brick and 12-in. pipe sewers.

Eagle Grove, Ia., will put in a complete system.

Kansas City, Mo.—The Board of Aldermen has under discussion the bonding of the city for $1,500,000 for building a complete sewerage system.

San Francisco, Cal.—Engineer Schussler, of the Spring Valley Water-Works, has planned an extensive sewerage system for the district near Lake Honda, one of the company's reservoirs.

Los Angeles, Cal.—The City Engineer has prepared plans for a $20,000 storm sewer.

ELECTRICAL.

Electric Light.—*Watkins, N. Y.*—Bids for street lighting will be received until Aug. 5 by the Board of Selectmen.

Oil City, Pa.—The City Council has decided to invite bids for supplying, on a 10-year contract, not less than one hundred 2,000 c. p. arc and one thousand 16 c. p. incandescent lamps.

Greensboro, N. C.—A company with $1,000,000 capital has been organized to build water-works and an electric light plant here. L. L. Wolkins, Boston, Mass., is interested.

Waynesboro, Ga.—Bids are wanted for constructing a complete plant. Address R. Scott.

Newton, Ia., will buy a 1,000-lamp plant.

Muncie, Kan.—A company with $1,000,000 capital has been formed by J. B Colton, N. and R. L. McAlpine, J. J. Johns and others for building a dam across the Kaw River and utilizing the power so gained for generating electricity, which can thus be obtained in sufficient quantities to light Kansas City and its suburbs at a very low cost.

Winona, Kan.—The lowest bid for supplying seventy 2,000 c. p. lamps on a two-year contract, using the Philadelphia moon schedule, was $89 per lamp per year.

Plants are proposed at Rutland, Vt., by the Marble City Electric Light and Power Co.; Ticonderoga, N. Y., where J. De Verennes is interested; Crafton and Duquesne, Pa; Laurel, Md., where J. Chollar is interested; Hulings, W. Va., by the Lumber Co.; Monroe and Shelby, N. C.; West Point, Ga.; Humboldt, Tenn.; Kalamazoo and Tecumseh, Mich.; Toledo and Atlantic, Ia.; Slater, Mo.; Batesville, where J. W. Hamilton can give information, and St. Petersburg, Ark.; Crown Hills and Oakland, Cal.

Extensions are planned at Springfield, Mass.; Ballston Spa, N. Y.; Towanda, Pa.; Little Rock, Ark.

New Companies.—The New York Electrical Device Co. has been incorporated at Alexandria, Va., with a capital of $500,000, by J. M. Glover, of St. Louis, and C. W. Fields, Jr., of New York. The Equitable Electric Co. has been incorporated with $500,000 by J. M. Glover, of St. Louis, and C. W. Fields, Jr., of New York. The People's Light, Heat and Power Co. has been incorporated at Asheville, N. C., by A. J. Lyman and others. The Augusta, Ga., Electric Light and Motor Co. has been incorporated by R. M. Spiney and others. The North American Electric Light and Power Co., Springfield, Ill.; capital, $5,000,000; incorporators, H. C. Wilson, N. Dubois, G. J. Barrett, Monongahela City, Pa., Electric Light Co.; capital, $40,000; directors, E. G. Acheson, S. A. Duncan and W. W. Acheson, of Pittsburg.

CONTRACTING.

Paving.—*Albany, N. Y.*—A contract for granite paving has been awarded to J. Holler at $2.85 per sq. yd. for pave-

ment; curbing, 98 cts. per ft.; 6-inch curb, $1.15 per ft.; crosswalks, 38 cts. per sq. ft.; receiving basins, $80 each;

The Trinidad Asphalt Paving Co. have a $213,758 contract; their prices were: $3.15 per sq. yd. of pavement, curb, 80 cts. per sq. ft.; circular curb, 80 cts. per ft.; repairs to asphalt, $1; trees, $5 each; sidewalks with new flag, $2.19 per lin. ft.; sidewalks with old flag, $1.18 per lin. ft.

Buffalo, N. Y.—The Barber Asphalt Co. have received contracts amounting to $302,000.

Pittsburg, Pa.—Fire brick is being laid at $1.63 per sq. yd.

Chattanooga, Tenn.—The Southern Construction Co. have a contract for Hallwood brick on a 6-inch concrete foundation at $2.30 per sq. yd., with 5 years guarantee. The Warren Scharf Asphalt Pavement Co. have a contract for Trinidad sheet asphalt on 6 inches of concrete, at $2.82 per sq. yd. with 5 years guarantee, and $3.20, with 10 years guarantee. The Southern Pavement Co. will lay compressed asphalt blocks on 6 inches of concrete, at $2.83 per sq. yd., with 5 years guarantee. M. E. Maher has a contract for Georgia granite blocks on sand foundations, at $2.74 per sq. yd., with 1 year guarantee. The total cost is estimated at $190,000.

Cincinnati, O.—The Warren Scharf Co. has a $79,000 contract.

Detroit, Mich.—Recent bids for cedar block on sand-bed were at $1.24 per sq. yd.; for cedar block on concrete bed, $1.64 per sq. yd.; for cedar block on a plank and sand bed, $1.23 per sq. yd.

Kansas City Mo.—Contracts for curbing have been let at 41 cts. per ft.; cedar block pavement, $1.25 to $1.31 per sq. yd.; fire brick pavement, $1.78 per sq. yd.; macadamizing, $1.08 per sq. yd.

Sewers.—*Albany, N. Y.*—A recent contract for vitrified pipe was at $1.60 per ft. for 15-in. pipe; 42 cts. per lin. ft. for 12 in. box drain; manholes, $70.

Baltimore, Md.—Materials for sewer construction have been bought at $112 per m. for paving stones, 65 cts. per cu. yd. for sand, $8.25 per m. for hand brick, $7.70 per m. for machine brick.

Marion, O.—The bids on the recent sewerage system contract ranged from 30 to 65 cts. per cu. yd. for excavating, $3 to $6 per cu. yd. for masonry, $10 to $25 each for manholes, $7.50 to $12 for manhole covers; total, $13,684, $19,180. Irwin & Maher, Greenville, O., the lowest bidders, have the contract.

Milwaukee, Wis.—Contracts for pipe sewers were recently let at $1.50 per lin. ft. for 16-in pipe, $1.30 for 15-in., $1.20 for 12-in.

Kansas City, Mo.—The bid of T. J. Kelley for the first half-mile of the O. K. sewer was $9.80 per lin. ft for 6-ft. sewer, $8.60 per ft. for 6½ ft., $9.28 per ft. for 8¼ ft., $10.23 per ft. for 8¾ ft., $40 each for manholes, $4 per cu. yd. for rubble masonry, $5 for concrete masonry; broken stone $1.25 per cu. yd. Bricker, Douglass & Co.'s bid for the second half-mile was $18.17 per lin. ft. for $10½-ft. sewer, $18.90 per ft. for 11 ft., $19.86 per ft. for 11¼ ft., $19.48 for 11½ ft.; manholes at $25 each; rubble masonry, $4.50 per cu. yd., concrete masonry $5 per cu. yd., broken stone $1 per cu. yd.

per ft. for 18-in. pipe, 50 cts. per ft. for 24-in. pipe, $7.50 per cu. yd. for Portland cement concrete, $5.50 per cu. yd. for American cement concrete, $12.25 per cu. yd. for Portland cement masonry of abutments, $10.50 per cu. yd. for American cement masonry of abutments, $16 per cu. yd. for masonry in arch sheeting, $8 per cu. yd. for masonry of wings and external spandrels, $8 per cu. yd. for masonry in backings, $8 per cu. yd. for masonry in retaining walls, $21 per cu. yd. for masonry in parapet walls, $10 per cu. yd. for masonry in interior spandrels, $50 per cu. yd. for granite voussoirs, $1 per lin. ft. of sandstone curbing, $2 per sq. ft. of flagging, $1.50 per sq. ft. brick paving, $150 for each insulated pole. Total, $109,584.

PROPOSALS OPEN.

Streets.—*Brooklyn, N. Y.*—Grading and paving with cobblestone. J. J. Adams. Aug. 5.

New York City.—21,620 sq. yds. trap block, pavement, 7,670 ft. new curbing, 30,000 sq. ft. new flagging, 13,500 cu. yds. earth and 17,600 cu. yds. rock excavation, 55,000 cu. yds. filling. Thos. Gilroy. Aug. 6.

York, Pa.—2,000 cu. yds. excavation and 5,500 sq. yds. brick paving.

Baltimore, Md.—Sheet Granolithic pavement. A. E. Smyrk. Aug. 12.

Bond Hill, O.—A. C. Maish. Aug. 4.

Cleveland, O.—Grading, draining and paving with Medina stone. C. G. Force. Aug. 21.

North Peoria, Ill.—Grading and paving. O. J. Bailey. Aug. 11.

St. Paul, Minn.—Grading. R. L. Gorman. Aug. 5.

Waco, Tex.—Grading. C. C. McCullock. Aug. 7.

Sewers.—*New York City.*—12-in. pipe. T. F. Gilroy. Aug 6.

Poughkeepsie, N. Y.—Estimated cost, $2,000. C. E. Fowler. Aug. 5.

Baltimore, Md.—A. E. Smyrk. Aug. 6.

Cleveland, O.—C. G. Force. Aug. 7.

Brantford, Ont.—10,730 ft. brick sewer. W. Chipman. Aug. 12.

Water Pipes.—*St. Louis, Mo.*—43,300 lin. ft. 6-in. pipe; 2,150 ft. 8-in.; 4,400 ft. 12-in.; 3,600 ft. 20 in.; 100 fire plugs.

Artesian Well.—*Ellis Island, N. Y.*—J. B. Weber, New York City. Aug. 12.

Windmill.—*Fergus, Ont.*—J. Beattie. Aug. 29.

Round-Houses and Shops.—*Baltimore & Ohio R. R.*—H. T. Douglas, Baltimore, Md. Aug. 12.

Tunnel Brick Work.—*St. Louis, Mo.*—3,000 cu. yds. McCormick & O'Meara. Oct. 1.

Dry Docks.—*Port Royal, S. C.*—Timber dock and floating iron dock. Bureau of Yards and Docks, Washington, D. C. Nov. 1.

Rebuilding Wharf.—*League Island, Pa.*—Bureau of Yards and Docks, Washington, D. C. Sept. 2.

Railroad Work.—*Pittsburg, Pa.*—G. Rice. Aug. 4.

Passenger Station.—*Galion, O.*—A. Mozier. Aug. 15.

Iron Roofing.—*Brownwood, Ga.*—J. H. Ellerbee. *Dayton, Tenn.*—A. J. King. *Chester, S. C.*—Moffatt Mfg. Co.

Masonry Superstructure.—*Cincinnati, O.*—For canal bridge at Sycamore, O. F. Raine. Aug. 23.

Oswego, N. Y.—Removal and Renewal of Breakwater Superstructure.

Names of Bidders.	Leveling. Ballasting; labor only, 6,000 cu. yds.	Superstructure. Timber, 83,520 ft. b. m.	Iron, 4,442 lbs.	Oak Timber, 295,-266 ft. b. m.	Pine Timber, 858,-165 ft. b. m.	Pine Plank, 292,-500 b. m.	Screw bolts, 182,-411 lbs.	Drift bolts, 30,671 lbs.	Wood Screws, 2,756 lbs.	Spike, 18,217 lbs.	Mooring cleats, 15.	Total.
James B. Donnelly, Oswego, N. Y.	.60	$33.00	5 cts.	$38.00	$29.00	$28.00	3 1-5 cts.	2½ cts.	4 cts.	3 cts.	$8.00	$55,726
Campbell & Wood, Ithaca, N. Y.	.60	40.50	5 cts.	48.75	32.25	31.85	4¾ cts.	4¼ cts.	5 8-10 cts.	4 4 10 cts	4.85	66,689
Hoag & Pettididier, Pittsb'gh, Pa.	1.50	35.00	4 cts.	39.00	35.00	36.00	4 cts.	4 cts.	4 cts.	4 cts.	5.00	70,161

Manilla Rope.—*New York City.*—Recent bids ranged between 14⅝ and 15¼ cts. per lb. for 3-strand 3-in., and 13¾ and 15¼ cts. for 3-strand 5-in.

Stone.—*New York City.*—Prices for cobble stones have varied from 90 to 98 cts. per cu. yard. Rip-rap stone has been offered at 68 to 72 cts. per cu. yd.

Piles.—*New York City.*—Prices have been between $5.75 and $6.90 for 50 to 55-ft. sticks; $6.50 to $7.90 for 55 to 60-ft.; $7.60 to $8.90 for 60 to 65-ft. sticks.

Cements.—*New York City.*—Prices for slow-setting Portland have ranged in recent bids from $2.33 to $2.65 per bbl. and for quick-setting Portland from $2.42 to $2.65 per bbl.

Baltimore, Md.—Recent prices were: Cumberland, $1.35 a bbl. and $1.12 a bag; Portland, $3 a bbl.; Burnham, $2.75 a bbl.; Round Top, $1.12 a bag; German Portland, $2.75 a bbl.; Rosendale, $1.20 a bbl.; Crescent, $1.17 a bbl. and $1.07 a bag.

Stone Bridge.—*Wheeling, W. Va.*—Paige, Carey & Co., of New York, have received the contract at the following prices; 75 cts. per cu. yd. of grading, $1 per cu. yd. of excavation for abutments, 40 cts. per cu. yd. of excavation for wing walls, 3 cts. per cu. yd. per 100 ft. for hauling earth more than 300 ft., $27.50 per m. for white oak plank, 5 cts. per lb. for wrought iron spikes, 5 cts. per lb. for steel beams, 30 cts. per ft. for 12-in. clay pipe, 35 cts

MANUFACTURING AND TECHNICAL.

Cars.—The Chicago, Milwaukee & St. Paul Ry. have given an order for a number of parlor cars at $10,500 each to Barney, Smith & Co., Dayton, O. The Terre Haute & Indianapolis R. R. is building 8 passenger and 4 baggage cars at its shops in Terre Haute. The Gilbert Car Works, Glen Island, N. Y., have completed six passenger cars for the Great Falls & Canada R. R., and 6 sleeping cars for a South American company. The North Carolina Car Co. is building 100 freight cars for the Seaboard Air Line. The Ohio Falls Car Works have received recently contracts for 1,450 cars for two Southern roads. The Indianapolis Car Works turned out 148 new cars in the week ending July 26.

Car Works.—The Glasgow (Va.) Co. contemplate starting steel car-wheel works, a steel plant and cement works.

Locomotives.—The Housatonic R. R. has received 4 heavy freight mogul and 6 American type passenger engines from the Rogers Works. The Baldwin Works are engaged on some 150 engines for several roads and are turning out 2 a day. They recently shipped 3 locomotives for use on the road between Jaffa and Jerusalem. The Baltimore & Ohio R. R. has issued $2,000,000 of equipment bonds in order to buy more locomotives and freight cars. The New York, Pennsylvania & Ohio R. R. have recently bought 20 10-wheel freight locomotives.

A pumping station of 30,000 bbls. capacity will be built at Mt. Alto, Pa., by the Standard Oil Co.

Railroad Buildings.—The Pennsylvania R. R. will soon put up its iron foot bridge over West St., New York. The eastern end of this bridge will enter a brick and stone passenger station on the site of the present Western Union Hotel. The new boats will be double decked, to accommodate the elevated stations at New York and Jersey City. The office building of the company in Jersey City will be of brown stone and croton brick, 383 × 90 ft.

Public Buildings costing $100,000 at Fergus Falls, Minn., $24,000 at Snohomish, Wash., have been voted.

The Aerated Fuel Co., of New York, has introduced its system at the works of the Keystone Watch Co., Philadelphia, where it is found to work better than a coal fire for melting brass or copper in crucibles and in annealing.

Natural Gas has been struck near Parkersburg, Va.; Pomeroy, O., and Oakland, Cal.

The Hyatt Pure Water Co. will supply filter plants to the Eleventh Ave. Hotel, Pittsburg, Pa.; Hollenden Hotel, Cleveland, O.; Cordele, Ga., Ice Co.; Palmetto Ice Co., Columbia, S. C.; Evansville, Ind., Ice and Cold Storage Co.; Lackawanna Mills, Scranton, Pa.

The Pittsburg Reduction Co. is preparing plans for the erection of a new plant. Several sites on the Allegheny and Monongahela Rivers are under consideration. The firm has been obliged to increase its capacity six-fold since it began. A company has been recently started under the Pittsburg patents at Manchester, England.

The Union Water Meter Co., of Worcester, Mass., recently sent two 12-in. rotary piston water meters to the Passaic, N. J., Water Co. Engineers have previously been doubtful of the possibility of making 12-in. positive meters, but they are now shown to be feasible.

The Chapman Valve Co., Indian Orchard, Mass., will erect a new 120 × 50 ft. building to accommodate its increased business. The firm now employs about 220 regular workmen.

The River and Rail Electric Co., 45 Broadway, New York, have a storage battery car of their make on the Fort Hamilton line in Brooklyn, N. Y. This is the system described in our issue of Dec. 7, 1889, and it is generally regarded as of much novelty and promise.

New Companies.—Electric Engineering Co., Camden, N. J.; capital stock, $100,000; incorporators, H. Barton, H. Gianella, C. Schneider and others, of Philadelphia. The Edison Industrial Works, Bloomfield, N. J.; capital stock, $1,000,000; incorporators, T. A. Edison, T. Butler, S. B. Eason. Keystone Automatic Life-Saving Car-Coupling Co., Oakland, Cal.; capital stock, $10,000,000; directors, L. I. Mowry, J. L. Flood, J. W. Brown, B. Rochab and others. Kalamazo City & County Street Ry. Co., Kalamazoo, Mich.; capital stock, $130,000. South Lyons, Mich., & Pontiac Ry. Co.; capital stock, $400,000. Eureka Cement Co., Owosso, Mich.; capital stock, $100,000. Underground Electric Light Co., Chicago, Ill.; capital stock, $1,000,000; incorporators, A. J. Cooper, C. A. Munsen and F. G. O'Connell. United States Electric Car Co., Chicago, Ill.; capital stock, $3,000,000; incorporators, J. H. Donnelly, M. S. De Bolt and J. A. Qualey. Columbia Street Car Co., Chicago, Ill.; capital stock, $1,000,000; incorporators, P. L. McArdle, F. J. Short and A. H. Walker. National Fuel Gas Co., Lansing, Mich.; capital stock, $500,000. East Side Street Car and Motor Co., Baker City, Ore.; capital, $25,000; incorporators, J. P. Faull, G. Waggoner and P. Basche. Pacific Cement and Supply Co., Port Townsend, Wash.; capital stock, $10,000; incorporators, L. Mohr, J. Lillie and T. J. Nolton.

Metal Market Prices.—*Rails*—New York: $31 to $31.50; for old iron rails, $24 to $24.50; Chicago: $34 to $35.50; old rails, $26 to $26.50 for iron, $19.50 to $22 for steel. Pittsburg: old rails, $26.50 to $27 for iron; $21 to $22.50 for steel.

Foundry Pig-iron.—Chicago: $15.50 to $17.50. Pittsburg: $15.75 to $17.50. New York: $16 to $18.50.

Track Materials.—New York: steel angle bars, 1.75 to 1.9 cts.; spikes, $2 to $2.10; track bolts, 2.8 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.9 to 2 cts. for iron; spikes, 2.15 cts.; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.25 cts. for steel, and 2.05 to 2.1 cts. for iron; spikes, 2.10 to 2.15 cts; track bolts, 3.1 to 3.2 cts. with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.35 cts.; Chicago, 4.45 cts.

Structural Material.—Pittsburg: angles, 2.15 to 2.2 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared steel bridge plates, 2.65 to 2.75 cts.; universal mill plates, 2.5 cts.; refined bars, 1.90 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire box; 3.15 to 3.20 cts. for flange; 3 cts. for shell, 2.75 cts. for tank. New York: beams, 3.10 cts.; plates, 2.15 to 2.20 cts.; angles, 2.25 cts.; tees, 2.5 to 2.6 cts.; channels, 3.1 cts. Chicago: angle, 2.3 cts.; tees, 2.8 to 2.9 cts.; beams, 3.2 cts.; universal plates, 2.45 to 2.55 cts.

Commonwealth of Massachusetts.

Metropolitan Sewerage Commissioners.

NOTICE TO CONTRACTORS.

Sealed bids for building sections 8 and 9 of the Metropolitan Sewerage System (East Boston) and sections C and D (Brighton), all in the city of Boston, in accordance with the form of contract and specifications to be furnished by the Board of Metropolitan Sewerage Commissioners, will be received by said Board at its office, 93 Lincoln street, Boston, Mass., until 12 o'clock M. of Wednesday, Aug. 13, 1890.

No bid will be received unless accompanied by a certified check for the sum of one thousand dollars.

All bids must be made upon the blank forms furnished by the Board.

The external diameter of the sewer on sections 8 and 9 is from eleven to fifteen feet, and on sections C and D is from six and one half to nine feet. Some other particulars are approximately as follows:

Sec.	Length. Feet.	Av. depth. Feet.	Cub. yds. brick masonry.	Cub. yds. concrete masonry.	No. piles.
8.....	4,100	13	1,800	4,900	40
9.....	3,700	14	2,000	4,000	40
C.....	5,800	15	1,500	2,600	1,000
D.....	5,400	16.5	1,600	2,400	100

Plans can be seen and specifications and form of contract can be obtained at the above office.

Each bidder is required to make a statement indicating what sewer and similar work he has done, and to give references that will enable the Board to judge of his business standing.

The Board reserves the right to reject any and all bids.

HOSEA KINGMAN, TILLY HAYNES, ROBERT T. DAVIS. } Board of Metropolitan Sewerage Commissioners of Massachusetts.

HOWARD A. CARSON, Chief Engineer.

29 4t

Proposals for Sewer Construction.

City of Poughkeepsie, N. Y., Department of Water-Works and Sewers, Commissioners' Office, July 24, 1890. Sealed proposals will be received at this office until noon of Tuesday, Aug. 5, 1890, for constructing about 1,500 ft. of vitrified pipe sewers in this city. Plans and profiles may be seen, and specifications, contract, and forms of proposal, together with all necessary information, obtained on application at this office. All proposals must be made upon forms obtained at this office. The right is reserved to reject any or all proposals.

By order of Commissioners.

CHAS. E. FOWLER, Superintendent of Water-Works and Sewers.

30-2t.

Notice to Sewer Contractors.

Sealed proposals will be received by the Sewerage Committee of the Board of Aldermen of the city of Greensboro, N. C., at the Mayor's office of said city, until 3 o'clock P. M. of Thursday, Aug. 21, 1890, for constructing a part of the proposed system of pipe sewers for said city.

Copies of the general plans and specifications, forms of proposals, and instructions to contractors, and any information relative thereto, may be obtained from the Chairman or Engineer of the Sewerage Committee. The committee reserves the right to reject any or all bids.

WM. M. HOUSTON, Chairman Sewerage Committee.

J. L. LUDLOW, Engineer. 30-2t

Notice to Contractors.

Sealed proposals will be received by the "Citizen's Heat, Light and Power Co., of Blairsville," for the construction of a plant for furnishing heat, light and power by electricity to those who may require the same, in Blairsville and vicinity. Plans and specifications can be procured on application to D. A. Fenlon, Secretary, or Antes Snyder, President of said company, Blairsville, Indiana Co., Pa. Bids should be deposited with the Secretary by noon of the 15th day of August, 1890, and be marked "Bids on the Plant of the Citizen's Heat, Light and Power Co."

D. A. FENLON, Secretary.

31-2t BLAIRSVILLE, Indiana Co., Pa.

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

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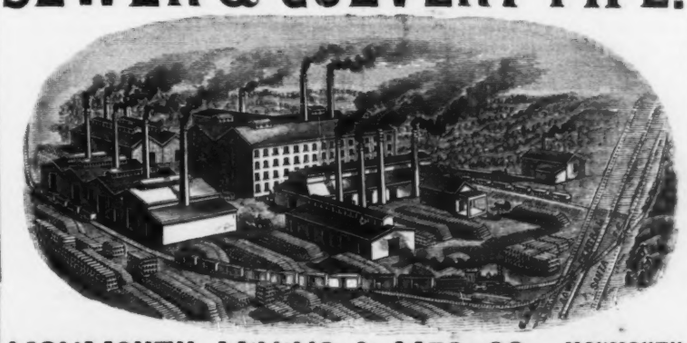

MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

Proposals for Key West Improvements.

OFFICE OF CITY CLERK, KEY WEST, Fla., June 2, 1890.

Sealed proposals will be received by the City Clerk of Key West, Fla., until 1st of September, 1890, for furnishing the necessary material and putting in an underground system of sewerage; also for grading and paving the streets of said city and furnishing the material for same; also for furnishing and laying of water mains.

1st. All bids must be made upon the printed forms to be obtained from the City Clerk and inclosed in a sealed envelope, directed to the Board of City Commissioners and marked on the outside of envelope, "Proposals for Key West Improvements."

2d. Each bid must be accompanied by a cash deposit or certified check of five hundred dollars, to be left in the hands of the City Clerk subject to the conditions specified, as a guarantee of the good faith of the bidder.

3d. The city reserves the right to reject any and all bids.

4th. Bidders are requested to be present at the opening of the bids.

5th. Bidders are expected to bid separately on sewer system and material, on grading and paving of streets and on furnishing and laying water mains.

6th. Plans and specifications can be seen at the office of the City Clerk and at the office of Johnson & Flad, Consulting Engineers, Laclede Building, St. Louis, Mo.

WM. L. DELANEY, City Clerk.

25-5t

Railroad Work to Let.

All the earthwork, clearing, grubbing, timber work and ties for 3½ miles on the Iron Range & Huron Bay R. R., between Huron Bay and Champion, in Baraga and Marquette counties, Michigan, will be let in whole or in sections.

Profiles and specifications can be seen at No. 55 Fort street, West Detroit, Mich., where bids will be received until 12 o'clock M., Aug. 14, 1890.

The right to reject any or all bids is reserved.

MILO H. DAVIS, Chief Engineer.

31-2t

Railroad Shops.

BALTIMORE & OHIO RAILROAD COMPANY, OFFICE OF CHIEF ENGINEER, BALTIMORE, Md., July 26, 1890.

Proposals will be received at this office until noon on Aug. 12, 1890, for furnishing materials and constructing, in accordance with Plans and Specifications, Roundhouses and Shops at Trinidad, on the Washington Branch, and Brunswick, on the Main Stem of the Baltimore & Ohio R. R.

Plans and Specifications may be seen at this office.

The right is reserved to reject any or all proposals.

H. T. DOUGLAS, Chief Engineer.

31-2t

Marysville, Ohio, Water-Works.

Sealed proposals will be received until noon of Friday, Aug. 15, 1890, by the Light and Water Co. of Marysville, O., for the following items for the Marysville Water-Works:

Six hundred (600) tons of cast iron water pipe, ranging from four (4) to twelve (12) inches diameter; thirty-two thousand (32,000) pounds of special castings; seventy-two (72) four (4) inch double nozzle fire hydrants; fifty-seven (57) stop valves from four (4) to twelve (12 inches diameter

Fifty-seven (57) stop-boxes for above valves.

Laying of above pipe, setting of above special castings, fire hydrants, stop valves and stop boxes.

One brick pumping station.

One masonry dam.

Two (2) duplex compound direct acting pumping engines, each of seven hundred and fifty thousand (750,000) gallons daily capacity, together with two (2) return tubular boilers, sheet iron chimney, and all appurtenances necessary to complete said machinery.

Proposals must be made on the blank forms furnished by the Light and Water Co., and all legal formalities must be complied with to secure consideration of the proposals.

Plans for above work may be examined and blank forms of proposal and specifications can be obtained at the office of the Light and Water Co., Marysville, O., or the office of the Consulting Engineer, rooms 21-22 Glenn Building, Cincinnati, O.

The proposals must be sealed and addressed to the Light and Water Co., Marysville, O., and be endorsed with the name of the person, firm or corporation which makes the tender, and be accompanied by a certified check payable to the order of the Treasurer of the Light and Water Co., as follows:

Water pipe and special castings	$300
Fire hydrants	200
Stop valves	150
Pipe laying	200
Pumping station	200
Pumping machinery	300
Masonry dam	150

The company reserves the right to reject any and all proposals.

THE LIGHT AND WATER CO.

JOHN F. ZWERNER, President.

JOHN W. HILL, Consulting Engineer, Cincinnati, O.

MARYSVILLE, O., July 28, 1890. 31-2t

Proposals.

Notice is hereby given that the Board of Experts appointed to prepare plans for the improvement of the termini of the New York and Brooklyn Bridge in the two cities, will receive plans for the improvement of the termini from any person who may choose to submit them. Plans must be in writing and must be accompanied by drawings. No compensation will be made to any person for plans or drawings submitted, unless such plans or drawings or some portion thereof shall be adopted, and in such case the compensation for such plan or drawing will be fixed and determined by the Board of Trustees. The decision of the Board of Trustees upon all questions relating to compensation shall be final and not subject to question or review.

The plans must be submitted to the Board of Experts addressed to C. W. Buchholz, Secretary, at the office of the Bridge Trustees, on or before Sept. 1. Due notice will be given hereafter of the time and place where oral explanations will be heard.

Any information concerning the subject matter can be obtained at any time at the office of the Trustees of the Bridge.

31-1t JAMES HOWELL, President.

Road Making and Maintenance

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Road Legislation for the American State,

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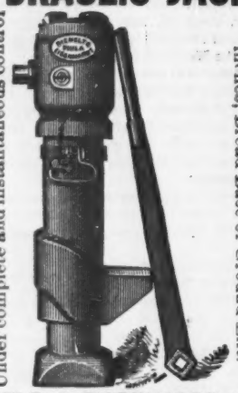

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Contractor for Dredging, Filling, Etc.
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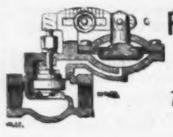

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WANTED.—To add to office force in large shops in Chicago, one or two Draftsmen experienced in Corliss and general engine designing; also, one or two Draftsmen experienced in mill building constructions and general machinery. Address C. F., care Engineering News. 26—

WANTED.—A first-class topographical draughtsman, one especially skilled in relief work, either pen or tint. Must be quick and reliable. Address (enclosing specimen of work and stating salary expected) NIEE, HARTFORD & MITCHELL, Chattanooga, Tenn. 29.

WANTED.—500 railroad laborers, teamsters, rock and track men for work on Burlington & Missouri River road, at Newcastle, Wyo. Free railroad transportation. Apply to H. P. THIELE & CO., 321 Walnut street, St. Louis, Mo.

WANTED.—A Civil Engineer who has had experience in designing plans for sewers and general city improvements. Must be a first-class draftsman and be able to take charge of party. Permanent position. Address "P. L. S.," care Engineering News. 28-4t

WANTED.—A good draughtsman, capable of taking charge of locomotive work in the office under the direction of chief draughtsman; must be correct and capable of making calculations, estimates, etc. Apply at once with references to PORTLAND COMPANY, Portland, Me. 29-3t

WANTED.—100 tracklayers and iron men. Good wages. Apply on the works at Middlesborough, Ky. ALLISON, SHAFER & CO., Contractors.

WANTED.—Two or more graduates having had professional experience, to fill vacancies in the corps of Assistant Professors in the College of Civil Engineering, of Cornell University. Good salary and prospects for suitable candidates. Address correspondence to Professor E. A. FUERTES, Director, Ithaca, N. Y. 29—6t

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WANTED.—Good field topographer. Must be familiar in taking contours in a mountain country. State experience and salary expected. Address CHIEF ENGINEER, M. & C. G. R. R., Morristown, Tenn. 31-2t

WANTED.—Information of Henry Meyers, Civil Engineer, formerly engaged in Iowa on railroad construction. Address R. P. McCORMICK, Civil Engineer and Contractor for Mississippi River Tunnel and Tower, 904 Olive street, St. Louis, Mo. 31-2t

WANTED.—Position by an engineer (30) experienced in railroad location and construction of heavy work, as tunneling, rock work, foundations, masonry, bridge erection and maintenance of way. Best of references. Address CIVIL ENGINEER, P. O. Box 568, Albuquerque, N. M. 31-3t

WANTED.—A civil engineer, 31 years old, graduate of a technical school, and with a varied experience, mostly on railroads, desires to ally himself with a good practising civil, mechanical or mining engineer in any good sized town of the United States. Address T. S. E., care of Jas. K. Gracie, 80 Broadway, New York. 31-3t

WANTED.—To let, 1,500,000 cubic yards graduation and 1,000,000 feet B. M. superstructure, piling, etc., on the Clarksville Mineral Branch of the Louisville & Nashville Railroad. Good work, good water and good prices. Profiles and specifications can be seen at our office and further information obtained by applying to the undersigned at Clarksville, Tenn.
MUNDY, McTIGHE & CO.

WANTED.—Two first-class bridge draughtsmen capable of making accurate shop drawings can obtain permanent positions. Address KING IRON BRIDGE & MFG. CO., Cleveland, O., and state salary and when services will be available. 31—

Contract Drawings of the New Croton Aqueduct.

From Croton Dam to Harlem River.

Plates 1 and 2.—Map and profile showing the route of the new Croton Aqueduct, location of shafts, blow-off and waste weirs, also route of the present aqueduct.

Plate 3.—Sheet No. 11, general form of aqueduct at north side of Harlem River. Sheet No. 3½ shows beginning of aqueduct at Croton River.

Plate 4.—Sheets No. 4, 4½ and 16 show tunnel excavation and masonry in various kinds of material.

Plate 5.—Sheet No. 5, Figs. 1 and 2, also sheet No. 6, show aqueduct under pressure in rock tunnel. Sheet No. 6½ shows aqueduct where it is in rock tunnel.

Plate 6.—Sheets Nos. 7 and 7½, general form of aqueduct in rock tunnel.

Plate 7.—Sheets Nos. 8, 8¼ and 8½, aqueduct without masonry, except floor. Sheet No. 25, aqueduct in earth and rock, water pressure overhead.

Plate 8.—Sheets Nos. 9 and 9½, tunnel excavation and masonry.

Plate 9.—Sheets Nos. 17, 18 and 20, aqueduct in rock tunnel. Sheets No. 19, Fig. 1, aqueduct on flooring. Fig. 2, on piles.

Plate 10.—Sheet No. 21, aqueduct in compact and loose rock. Sheets Nos. 22 and 23, aqueduct in earth. Sheet No. 24, aqueduct in tunnel requiring support.

Plate 11.—Sheet No. 13, shaft for aqueduct under pressure, south of Yonkers.

Plate 12.—Sheet No. 14, shaft for aqueduct under pressure, south of Yonkers.

Plate 13.—Sheet No. 15, masonry for shafts, aqueduct not under pressure.

Plate 14.—Sheet No. 31, blow-off and waste weir, to be built at South Yonkers.

Plate 15.—Sheet No. 28, blow-off and waste weir at Ashford on Saw Mill River.

Plate 16.—Sheet No. 26, blow-off and waste weir at Pocantico River.

Also, table of bids and prices.

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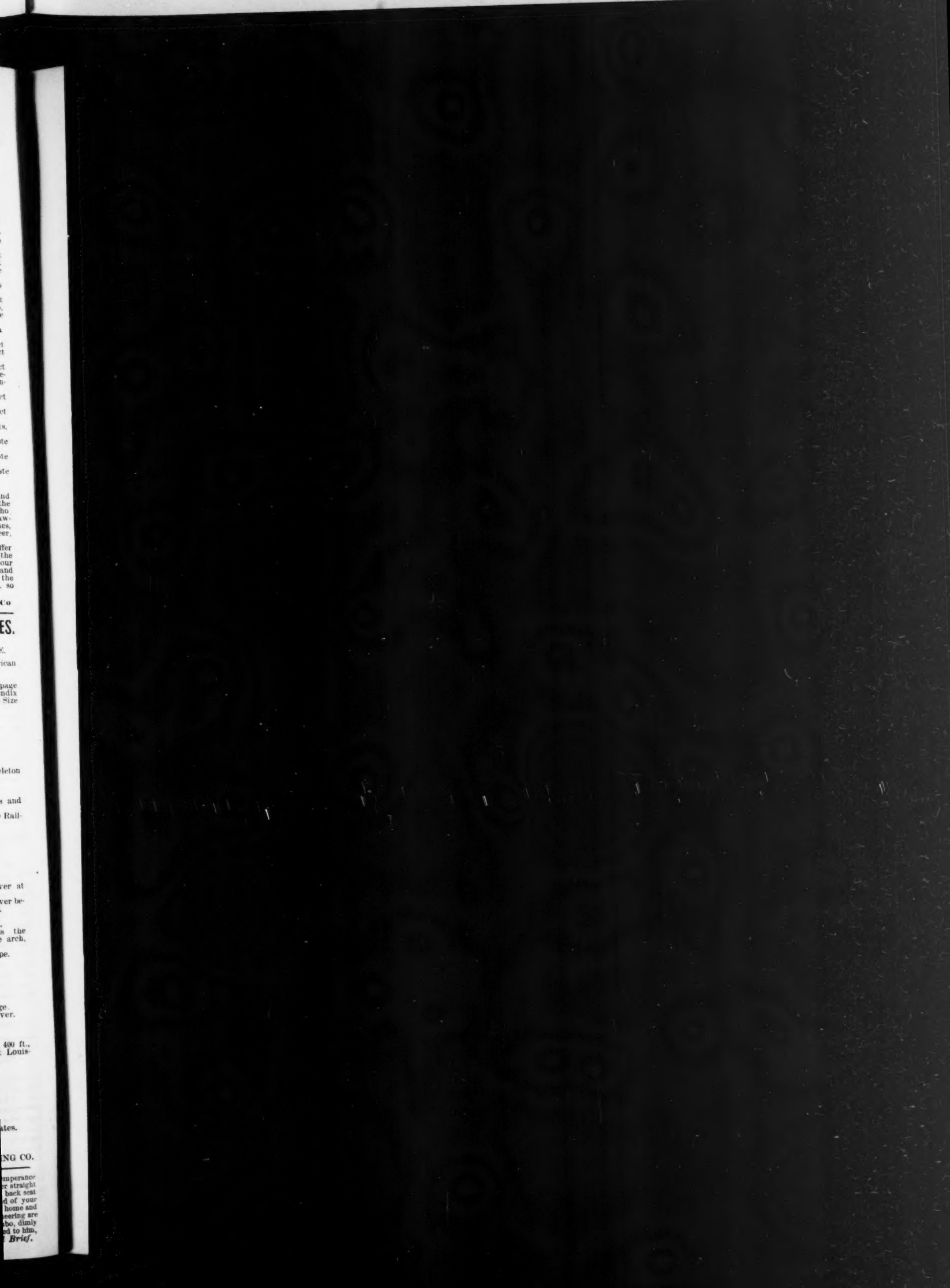
"My friend," earnestly exclaimed the temperance lecturer, pointing a long, quivering forefinger straight at the cowering figure of a man on the back seat "what will you do when you come to the end of your career and you find honor, hope, friends, home and all that makes life valuable or the future cheering are lost—all lost?" "Lost!" echoed Mr. Rambo, dimly conscious that a question had been addressed to him, "BeGeorge, I'd (hic) advertise!"—*Medical Brief.*